

# TECHNICAL REPORT

TR-RE-CCSD-FO-1045-3

February 17, 1967

# **SATURN IB PROGRAM**

# TEST REPORT FOR

GLOBE VALVE, 1  $\frac{1}{2}$ -INCH, 10C PSIG, PNEUMATICALLY OPERATED

Annin Company Model Number 1760-1501bASA

NASA Drawing Number 75M13138 HCLV-3

(CAMEGORY)



#### TEST REPORT

#### FOR

# CLOBE VALVE, 1-1-INCH, 100-PSIG, PNEUMATICALLY OPERATED

# Annin Company Model Number 1760-1501bASA

# NASA Drawing Number 75M3138 HCLV-3

#### ABSTRACT

This report presents the results of tests performed on three samples of the Globe Valve 75M3138 HCLV-3. The following tests were performed.

- 1. Receiving Inspection
- 2. Proof Pressure
- 3. Functional
- 4. Temperature Shock
- 5. Insulation Resistance
- 6. Icing
- 7. Sand and Dust\*
- 8. Salt Fog\*
- 9. Cycle

The three specimens tested failed to meet the requirements of the John F. Kennedy Space Center as stated in TP-RE-CCSD-FO-1045-2R and NASA Drawing Number 75M13138 HCLV-3. The following failures were revealed during testing:

# 1. Receiving Inspection

- a. Damaged specimens and shipping containers revealed that inadequate containers were used to support and protect the specimens during shipment.
- b. Missing parts, loose assemblies and improper signal pressure calibration indicate a failure to ascertain good workmanship.

### 2. Functional Operation

Two specimens failed to meet and maintain the minimum signal pressure requirement of 2.9 psig.

#### 3. Cycle

Three specimens failed to meet minimum internal leakage requirements of 15 sccm upon completion of 1,000 cycles of the 3,000 cycles required.

<sup>\*</sup> During these tests, the Bourns position indicator was removed from the valves and only the position indicator was subjected to the tests.

# TEST REPORT

FOR

GLOBE VALVE, 1-2-INCH, 100-PSIG, PNEUMATICALLY OPERATED

Annin Company Model Number 1760-1501bASA

NASA Drawing Number 75M13138 HCLV-3

February 17, 1967

### FOREWORD

The tests reported herein were conducted for the John F. Kennedy Space Center by Chrysler Corporation Space Division (CCSD), New Orleans, Louisiana. This document was prepared by CCSD under contract NAS8-4016, Part VII, CWO 271620.

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#### CHECK SHEET

#### **FOR**

# GLOBE VALVE, 1-2-INCH, 100-PSIG, PNEUMATICALLY OPERATED

MANUFACTURER: The Annin Company

MANUFACTURER'S MODEL NUMBER: 1760-1501bASA

NASA DRAWING NUMBER: 75ML3138 HCLV-3

TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, Louisiana

AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

> OPERATING MEDIUM: Valve: Liquid hydrogen

Actuator: Gaseous nitrogen Indicator: Gaseous nitrogen

B. OPERATING PRESSURE: Valve: 100 psig

Actuator: 50 psig; signal 3 to 15 psig Indicator: 50 psig

C. VALVE CAPACITY:

 $C_{v} = 13 \pm 0.5$ D. LEAKAGE: Internal - 15 sccm

External - none

E. VALVE OPERATION: Vertical, pilot operated, and spring

to close.

F. VACUUM:

RESPONSE SPEED:

10 microns of Hg or less

0.2 inch per second

#### CONSTRUCTION II.

A. BODY, BONNET, AND JACKET

MATERIAL:

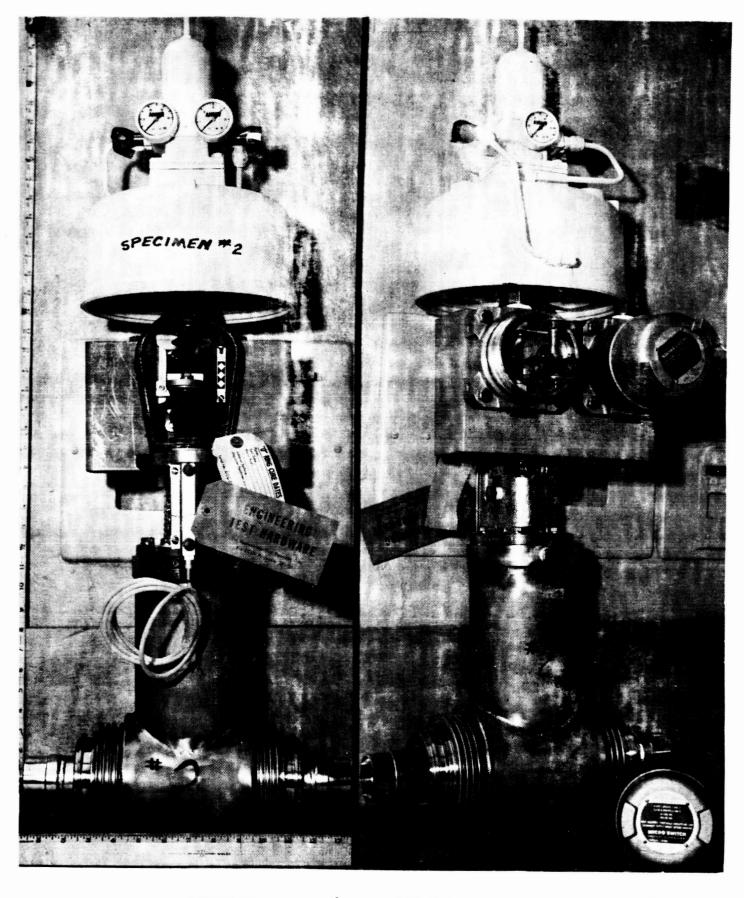
B. VALVE TRIM:

C. VALVE YOKE:

D. SOFT SEAL PLUG INSERT:

Type 304 stainless Austenitic stainless Austenitic stainless

Kel-F



Globe Valve, 75M13138 HGLV-3,  $1\frac{1}{2}$ -Inch, 100-Psig, Pneumatically Operated

#### CHECK SHEET

#### FOR

#### POSITION INDICATOR

MANUFACTURER: Bourns Laboratories, Inc.

MANUFACTURER'S MODEL NUMBER: 156

TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, Louisiana

AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

A. PURGE MEDIUM:

Dry GN<sub>2</sub> 5,000 ohms ± 5% B. RESISTANCE:

C. OPERATING PRESSURE: 50 psig

II. CONSTRUCTION

> A. WIRE TYPE Evanohm

B. CONNECTIONS: Pressure - MS33356-2 Style "G"

Electrical - 1/2-inch MPT

C. SHAFT: Stainless steel

D. MOUNTING LUGS: Stainless steel E. CASE:

Stainless steel

F. END PLUGS: Stainless steel

L			-	Test Resul	.8	
_ 1	Operational Boundary	Test Objective	Specimen	Specimen 2	Specimen 3	Remarks
>	Visual and Limensional Examination	To determine if specimens conforms to vendor drawings A4951, P5483, P5833, and A4806	ís.	ĹĿ	s	Specimens 1 and 2 complied with ventor drawings. Evidence to poor workmanship, improper secking and
	•	Examine for poor workmanship and manufacturing defects.				Speciaen ) complicit with vendor drawings.  Speciaen ) complicit with vendor drawings.  No syldence of poor corteanship, improper esching; said manufacturing defects was observed.
>40>:	Valve Body - 150 paig for 5 minutes Actuator - 75 paig for 5 minutes Signal Port - 22 paig for 5 minutes Genum Jecket - 20 paig for 5 minutes	Maintain all pressures	ແພພສ	იიათი	တလလတ	8
> #1	Vactum Jacket - IALU 'AIM cc/sec. Bourns Indicator - 75 psig for 5 minutes INTERNAL SEAT LEAKAGE - 15 SCCM FOR	Operate withing specification limits	ωt•	N Fr	លឝ	of holding prepare
~ =	> MINUTES I. Upstream Pressure - 100 psig					Upstream Pressure 4t 100 pelg. Failed to operate at actuator presents of 20 pass
			w	κ	ß	
	(+0, -0.1) psig  B) Actuator Pressure - 20 psig  1. Signal Pressure - 2.9		ß	w	ro	actuator pressure d'2
	(+0, -0.1) psig c) Actuator Pressure - 0.0 pisg l. Signal Pressure - 0.0 psig	·	80	67	60	Valvo eracked and reseated at less than 2:5 seran
-	II. Downstgeam Pressure - 25 psig A) Actuator Pressure - 50 psig 1. Signal Pressure - 2.9		တ	Ø	ß	est requirements.
	(+0, _0.1) page B) Actuator Pressure - 20 page		íz,	ى د	so.	LI.
	1. Jignal Fressure - 2.7 (+0, -0.1) psig C).Actuator Pressure 0.0psig 1. Signal Pressure - 0.0 psig		တ	w	Ŋ	completed at and
	EXTERNAL LEAKAGE - NONE		s	ø,	w	
	VACUUM JACKET - LESS THAN 10 MICHONS		Ŋ	ω	ω	
	ACTUATOR SIGNAL - UPSTREAM PRESSURE 100 PSIG				· · · ·	
	I. Actuator Pressure - 50 psig A) Signal Pressure - 3.0 to 15 psig		ſĸ.	ω	(z.	
	<pre>II. Actuator Pressure - 20 psig A Signal Pressure - 3.0 to 15 psig</pre>		6.	ý	<b>4.</b> .	44.4
	VALVE STEM MINIMUM TRAVEL SPEED - 0.2 INCH PER SECOND			1		
	I. Actuator Pressure - 50 psig		<b>p.</b>	ω		
	II. Actuator Pressure - 20 psig		<b>(</b> 24.	s	· p.,	

CLOBE VAIVE, 1-1-INCH, 100 PSIG, PKEUMATICALLY OPERATED 75M13138 HCLV-3

The first control of the control of						The Day of		
Decrease notice of the control of th	Bry Pohlaent	Units	Operational Boundary	Test Objective		Specimen 2	Specimen	Remarks
11. Open 11. Constitution building buildings allocated to the control of the cont			, ,					
11. Closed 2 Objective temperature at 125°F thm 2 connected translation shock 3 Objective temperature at 125°F thm 3 objective temperature shock 4 Objective temperature at 125°F thm 4 Objective temperature shock 5 Objective temperature to the sequence of temperature shock temperature shock 6 Objective temperature to the sequence of temperature shock temperature shock temperature to the sequence of temperature to the sequence of temperature of 15° shock temperature of			POSITION INDICATOR SWITCHES		o	U	v,	
This continues show the continues by floating disputation of the continues			I. Open		o.	,	)	
Substitute abook 2 Statistics that Entered at 125° then consistence abook consistence at 125° then 25°			II. Closed		;	(	p	c Martinago
did fret	Temperature Shock	74	Stabilize temperature at 125°F then cool within 2 minutes by flowing GHz and then LH <sub>2</sub>	Determine if specimens's performance is impaired by temperature shock	V V	va .	<u>.</u>	signal pressure out of tol
Abition Served to the antinoum description of determine performance of 2 feat interests, at a minimum distance of 2 feat interests, and and and dust of 2 feat interests of 2 feat interests of 3 minimum of 3 feat interests of 3 feat in	Inculation Resistance	6	20 megohms, at 500 vdc for more than 60 seconds	To determine resistance between non connected terminals and case	σ	တ	σ	All specimens successfully completed requirements.
Secretaries and the control of and and dust independent of foreign to the control of source of s		8	Maintain 5°F Spray droplets, with a minimum diameter of 1.5 millimeters, at a minimum distance of 2 feat	To determine if specimen's performance is impaired by icing	NA	íι	[z.	SPECIMEN 2 Leak on packing flange gland during icing Cland tightened. No leak on post icing functional test.
Mathematic description of the control of the contro								SPECIMEN 3 Minimum signal pressure and actuator pressure out tolerance.
The following contains temperature of 95°F (+2,*) To determine resistance of Bourns F NA Fail 1974 of 1974	Dagt. Test Indicator	н	Maintain density level of sand and dust between 0.1 and 0.25 gram per cubic foot even at any velocity between 100 and 500 feet per minute, Temperatures 0.777 and 126% for 2 hours at each tempera.	To determine resistance of Bourns indicator to fine blowing sand and dust particles	Ø	NA	NA	Successfully completed requirements.
Maintain temperature of 95°F (+2, _2°F   Indicator co a sait atmosphere   F   NA   Fail   Maintain temperature of 95°F (+2, _2°F   Indicator co a sait atmosphere   P   F   F   SPB   Sparts by weight of sadium chirds and   Sparts by weight of sadium chirds and failures   Signal Port - & Oo paig for 5 minutes   Signal Port - &								
To determine if specimen's performance F F F SPB is impaired by cycling is performance F F F SPB in the second of	Moura indicat	. <del>.</del>	Maintain temperature of 95°F (+2, .4°F using a sait solution consisting of 5 parts by weight of sodium chloride and 95 parts by weight of water for 240 hours	To determine resistance of Bourns indicator to a salt atmosphere	ĵu,	A N	NA	Failed during cycling due to salt fog deterioration.
SPE STATE Pressure Test 2 Valve Body - 400 paig for 5 minutes Maintain all pressures; and photograph Actuator - 200 paig for 5 minutes and failures Signal Port - 60 paig for 5 minutes Bourters and failures Bourtes Indicator - 200 paig for 5 minutes Signal Port - 60 paig for 5 minutes and failures and failures Signal Port - 60 paig for 5 minutes and failures Signal Port - 60 paig for 5 minutes Signal Port - 60 paig for 5 mi	a	m	3000 cycles	0	[2-,	Įz.	(E4	SPECIMEN 1 Treated with signal pressure of 2.4 to 15 psignal arthurton pressure of 50 psignal
SPECIAL STATE Body - 400 psig for 5 minutes  Actuator - 200 psig for 5 minutes  Signal Port - 60 psig for 5 minutes  Bourns Indicator - 200 psig for 5 minutes  Bourns Indicator - 200 psig for 5 minutes  Bourns Indicator - 200 psig for 5 minutes  Signal Port - 60 psig fo		·						Failed on precycle functional test. Lisassembly revealed springbutton adjusting assembly on domotor rotated. The specimen failed leakage tolerances after 1000 cycles.
Maintain all pressures; and photograph  Actuator 200 psig for 5 minutes  Signal Port - 60 psig for 5 minutes  Burns Indicator - 300 psig for 5 minutes  Burns Indicator - 300 psig for 5 minutes  Burns Indicator - 300 psig for 5 minutes  Actuator - 300 psig for 5 minutes  Signal Port - 60 psig for 5 minutes  Signal Port - 300 psig for 5 minutes  Signal Port - 300 psig for 5 minutes  Signal Port - 300 psig for 5 minutes  Signal Port - 60 psig for 5 minut								SPECIMEN 2 Tested with signal pressure of 2.9 to 15 psig Falled leakage tolerance at 1000 syclas Falled leakage tolerance at 1000 syclas Falled leakage tolerance at 100 syclas
Maintain all pressures; and photograph  Actuator - 200 psig for 5 minutes  Signal Port - 60 psig for 5 minutes  Bournes Indicator - 200 psig for 5 minutes  Bournes Indicator - 200 psig for 5 minutes  Bournes Indicator - 200 psig for 5 minutes  Representation and photograph  Signal Port - 200 psig for 5 minutes  Signal Port - 200 psig for 5 minutes  Solution in the signal protograph  Signal Port - 200 psig for 5 minutes  Solution in the signal protograph  Signal Port - 200 psig for 5 minutes  Signal Port - 200 psig for 5 minutes  Signal Port - 200 psig for 5 minutes  Signal Port - 60 psig for 5 mi								Leasementy Tyreater actuping, seal seat (ReL-F) worm, seal creavey (Teilou), compressed and pressure ring (SS) loose.
Burns Indicator - 200 psig for 5 minutes Maintain all pressures; and photograph  Actuator - 200 psig for 5 minutes  Signal Port - 60 psig for 5 minutes  Bourns Indicator - 200 psig for 5 minutes  Bourns Indicator - 200 psig for 5 minutes  "To be a print of the pressure of the pressures and failures  "To be a print of the pressure of the pressures and photograph  Actuator - 400 psig for 5 minutes  "To be a print of the pressure of the pressures and photograph  Actuator - 400 psig for 5 minutes  "To be a print of the pressure of the press								SPECIMENT 3 Tester with signal pressure of 2.4 to 15 psig. Failed leakage tolerance upon completion of
Maintain all pressure Test 2 Valve Body - 400 psig for 5 minutes Actuator - 200 psig for 5 minutes all ruptures and failures Signal Port - 60 psig for 5 minutes  Bourns Indicator - 200 psig for 5 minutes								JOUR SYLES. ROUTES indicator on specimen 1 failed after 100 cycles ine to the effects of salt fog environment.
- 200 paig for 5		۲۷	- 400 ps <b>ig for</b> 200 psig for 5 - 60 psig for	Maintain all pressures: and photograph all ruptures and failures				Burst Pressure Test cancelled due to possible further testing.
			- 200 psig for					No Hurst Pressure Test performed due to failures.

#### SECTION I

#### INTRODUCTION

#### 1.1 SCOPE

This report presents the results of tests that were performed to determine if Globe Valve 75M13138 HCLV-3 meets the operational requirements for John F. Kennedy Space Center Launch Complexes 34 and 37B. A summary of the test results is presented on pages x and xi.

# 1.2 <u>ITEM DESCRIPTION</u>

#### 1.2.1 VALVE

- 1.2.1.1 Globe valve 75M13138 HCLV-3 is a 1-1/2-inch valve with 150-pound ASA raised-face flanges and is manufactured by The Annin Company, Montebellow, California. The valve serves as a control valve in the Saturn IB LH<sub>2</sub> replenishing system.
- 1.2.1.2 The valve is 10-1/2 inches face-to-face and approximately 37 inches from the bottom of the flange to the top of the actuator housing. The valve is vacuum jacketed and is pneumatically operated from an isolated signal source. The valve body is a one piece pattern with integral seat and extension bonnet. There are no mechanical joints within the vacuum jacket. The fluid medium flows down over the seat and can be throttled while flowing. The normal valve flow medium is liquid hydrogen and the actuator medium is gaseous nitrogen. The actuator is a spring-to-close type and will close in any instance of actuator or signal pressure failure. Two explosion-proof, snap-action switches enclosed in weatherproof housing are incorporated to indicate full open and full closed position of the valve.

#### 1.2.2 INDICATOR

Globe valve 75M13138 HCLV-3 has a Bourns Model 156 position indicator mounted on the valve to indicate the interim valve positions. The indicator is furnished with MS 33656-2 pressure fittings for gaseous supply and a 1/2-inch MPT for electrical conduit connection. The indicator is manufactured by Bourns Laboratories, Inc., Riverside, California, is approximately 4-3/4 inches long, and is 1 inch square. The lugs, case and shaft are stainless steel and the resistor is of the Evanohm wire type. Stem travel of the valve stem is 1-1/2 inches and the indicator resistance varies from 0 to 5000 ohms.

# 1.3 APPLICABLE DOCUMENTS

The following documents contain the test requirements for Globe V alve 75M13138 HCLV-3 and the position indicator.

- a. KSC-STD-164(D), Standard Environmental Test Methods for Ground Support Equipment Installations at Cape Kennedy.
- b. NASA Drawings 75M15154 and 75M13138 HCLV-3.
- c. Cleanliness Standard, MSFC-STD-164.
- d. Test Plan CCSD-FO-1045-1R.
- e. Test Procedure TP-RE-CCSD-FO-1045-2R.

#### SECTION II

#### RECEIVING INSPECTION

# 2.1 TEST REQUIREMENTS

Each specimen shall be visually and dimensionally inspected for conformance to the applicable specifications prior to testing.

#### 2.2 TEST PROCEDURE

- 2.2.1 A visitual and dimensional inspection of each of the three specimens was performed to determine compliance with NASA drawing 75M13138 HCLV-3 and the applicable vendor drawings (A4806 and A4951) to the extent possible without disassembly of the test specimens. At the same time the specimens were also inspected for poor workmanship and manufacturing defects.
- 2.2.2 All pressure gages were removed, and their accuracy was determined. The gages were then reinstalled on the specimens.

#### 2.3 TEST RESULTS

# 2.3.1 Specimen 1

The specimen complied with NASA drawing 75M13138 HCLV-3 and vendor drawings A-4951 and A-4806. The following evidence of poor workmanship and manufacturing defects were observed and reported in Interim Report GSE 031:

- 1. Bracket (part number 41110) was bent on the lower section of valve mounting. (See figure 2-1).
- 2. Misalignment of lock stem (part number 41841) and bracket (part number 41827). (See figure 2-5).
- 3. Caps on Bourns position indicator were missing and allowed the indicator ports to become plugged with packing material. (See figure 2-5),
- 4. Shipping containers failed to support and protect the specimen during shipment. (See figure 2-2).
- 5. The cap screws (part number 25026) were too short and allowed no thread margin. (See figure 2-3).
- 6. Cap screw 1-FN4 (part number A-4951) stripped off. (See figure 2-4).

## 2.3.2 Specimen 2

The specimen complied with NASA drawing 75M13138 HCLV-3 and vendor drawings A-4951 and A4806. The following evidence of poor work-manship and manufacturing defects were observed and reported in Interim Report GSE 031:

- 1. Cap screw, hex head 5/16 x 18 x 5/8 (part number 12484), missing. (See figure 2-1).
- 2. Nut (part number 41842) missing from Bourns position indicator. (Photograph not available).
- 3. Misalignment of lock stem (part number 41841) and bracket (part number 41827). (See figure 2-5).

# 2.3.3 Specimen 3

The specimen complied with NASA drawing 75M13138 HCLV-3 and vendor drawings A-4951 and A-4806. No evidence of poor work-manship or manufacturing defects was observed.

### 2.4 TEST DATA

The data presented in tables 2-1, 2-2, and 2-3 were recorded during the inspection of the three specimens.

Table 2-1. Specimen Nomenclature

		Valve		Domotar		Posi	Position Indicator	or.
	Name	Serial No. Model	Model	Name	N/S	Name	Serial No. Part No.	Part No.
Specimen 1	Annin	1-1-60909	1760	Worthington	None	Bourns Laboratories	35-224	2001566206
Specimen 2	Annin	60609-1-2	1760	Worthington	None	Bourns Laboratohies	13-534	2001566206
Specimen 3	Annin	60609-1-3	1760	Worthington	None	Bourns Laboratories	22-174	2001 566206

Table 2-2. Specimen Dimensions

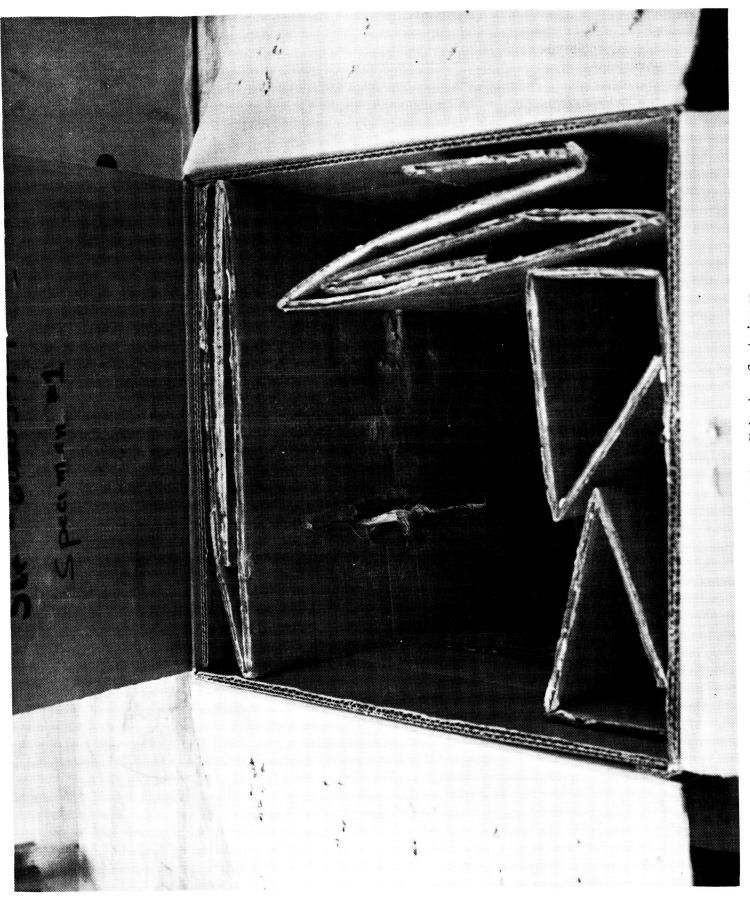
	Inlet Port	ırt	Outlet Port	ort	Overall	Vacuum	Bellows	Bourns Cord
	OD	Œ	OD	ΩI	Length	Jacket OD	QO .	Length
Specimen 1	1.938	1.767	1.937	1.770	13.5	3.5	2.0	99
Specimen 2	1.938	1,767	1.937	1.770	13.5	3.5	2.0	59₹
Specimen 3	1.938	1.771	1.938	1.769	13.5	3.5	2.0	. 60

Note: All dimensions are in inches

Table 2-3. Specimen Gage Accuracy

	Signal Pressure Gage (Percent)	Supply Pressure Gage (Percent)	Actuator Pressure Gage (Percent)
Specimen 1	91.0	98.1	98.2
Specimen 2	93.5	98.6	99.1
Specimen 3	90.3	97.1	96.6

Figure 2-1. Shipping Defects



2-6

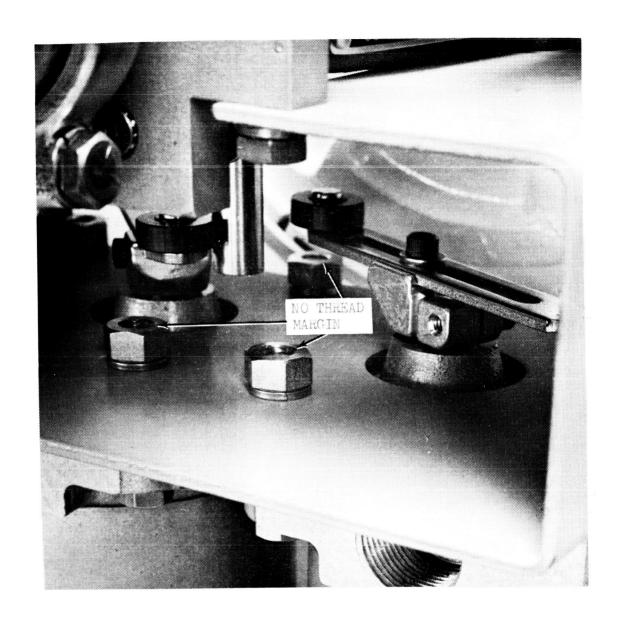


Figure 2-3. Manufacturing Defect

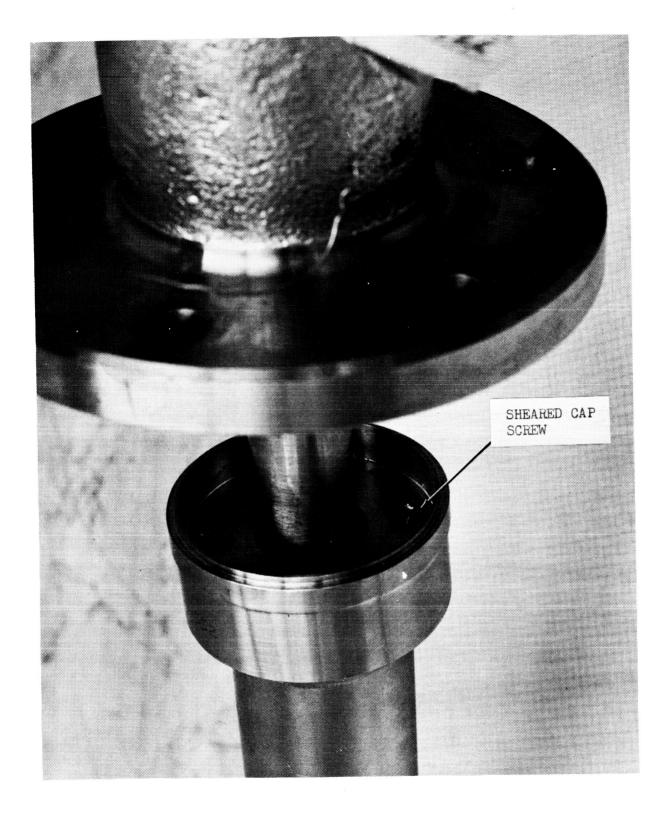


Figure 2-4. Poor Workmanship

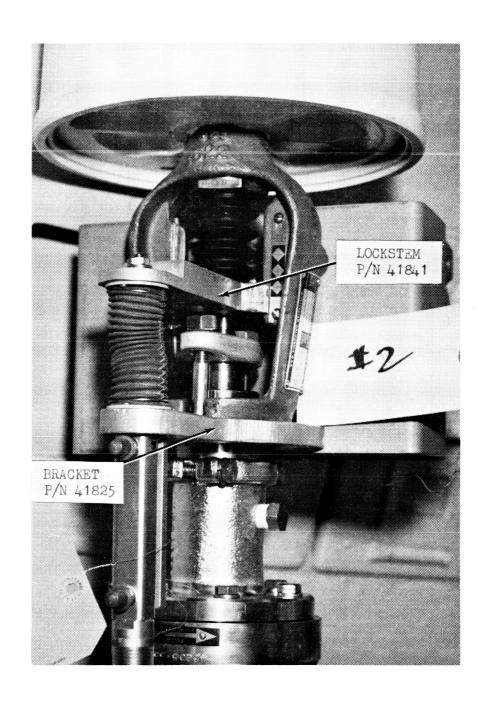
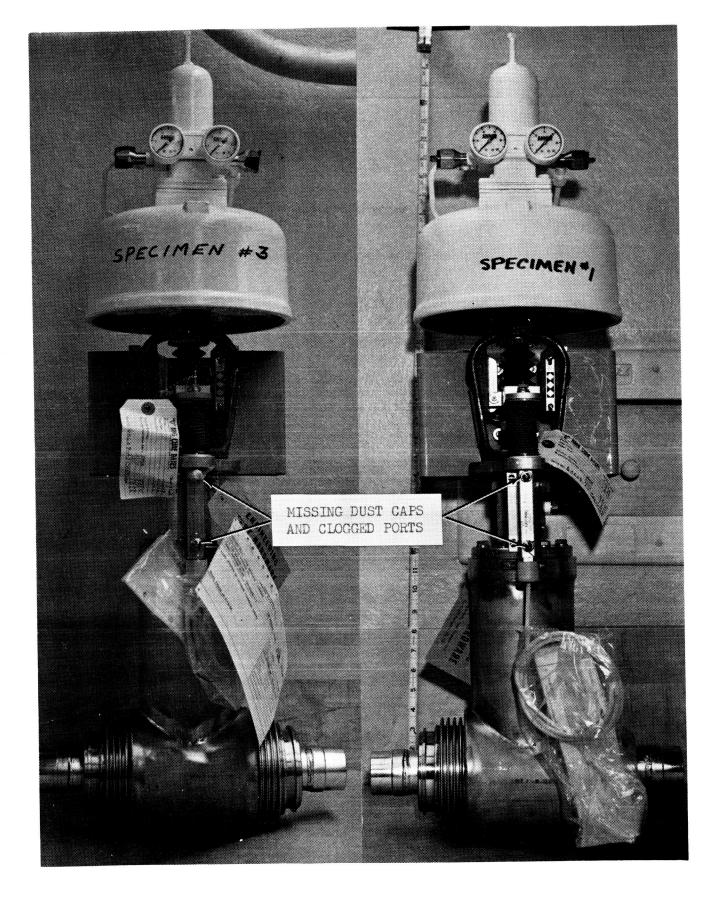


Figure 2-5. Misalignment of Bracket and Lockstem



Figuer 2-6. Missing Caps and Plugged Indicators

#### SECTION III

#### PROOF PRESSURE TEST

## 3.1 TEST REQUIREMENTS

- 3.1.1 The valve body of each specimen shall be pressurized with  $GN_2$  to the proof pressure of 150 psig. This pressure shall be maintained for 5 minutes and the specimen shall be checked for external leakage and distortion.
- 3.1.2 Each specimen actuator shall be pressurized with  $GN_2$  to the proof pressure of 75 psig. This pressure shall be maintained for 5 minutes and the actuator shall be checked for external leakage and distortion.
- 3.1.3 Each signal pressure port shall be pressurized with  $GN_2$  to the proof pressure of 22 psig. This pressure shall be maintained for 5 minutes and the specimens domotor shall be checked for external leakage and distortion.
- 3.1.4 The vacuum jacket shall be pressurized to 20 psig with GN<sub>2</sub>. This pressure shall be maintained for 5 minutes and the specimen shall be checked for internal and external leakage.
- 3.1.5 A standardized helium mass spectrometer shall be connected to the annular space (vacuum jacket) of the valve and the vacuum jacket shall be evacuated to a pressure of 0.05 microns of Hg absolute.
- 3.1.6 The inner line of the valve shall be pressurized to 100 psig with a He-N<sub>2</sub> mixture containing a minimum of 10 percent He. The outside of the valve shall be enclosed in a plastic bag and the bag shall be purged with He. The mass spectrometer shall be observed for leakage into the annular space of the valve. For acceptance of the valve the leakage shall be less than  $1 \times 10^{-7}$  atm cc/sec.

#### 3.2 TEST PROCEDURE

- 3.2.1 The test specimen was installed as shown in figure 3-1 using the equipment listed in table 3-1. It was determined that all connections were tight, gages were installed and operating properly, and all valves were closed.
  - 3.2.2 Hand valve 3 was opened and a pressure of 2200 psig was observed on gage 5.
  - 3.2.3 Hand valves 10 and 15 were opened and regulator 6 was adjusted until a pressure of 50 psig was observed on gage 8. Hand valve 15 was closed and regulator 6 was readjusted until a pressure of 15 psig was indicated on gage 8.

Hand valve 14 was opened and 15 psig opening pressure was routed 3.2.4 to the specimen actuator signal port. After the specimen reached the fully open position, hand valve 3.2.5 14 was closed. Hand valve 13 was opened and regulator 6 was readjusted until 3.2.6 gage 8 indicated 150 psig. Hand valve 10 was closed and the specimen pressure was maintained 3.2.7 for 5 minutes. During this period, regulator 6 was readjusted to 50 psig and hand valve 23 was opened. Gage 8 was monitored for leakage in the valve. The system was bled to zero psig by opening hand valve 9, 10, 3.2.8 14, and 15, and closing regulator 6 to zero outlet pressure. Hand valves 9, 13, 14, and 23 were closed and regulator 6 was 3.2.9 adjusted to slowly pressurize the specimen actuator to 75 psig. This pressure was monitored on gage 8. The pressure on the actuator was maintained for 5 minutes. Gage 3.2.10 8 was monitored. 3.2.11 Hand valve 9 was opened, regulator 6 was closed to zero outlet pressure, and the system was bled to zero psig as indicated on gage 8. Hand valves 9 and 15 were closed, hand valve 14 was opened and 3.2.12 regulator 6 was adjusted to slowly pressurize the actuator signal port to 22 psig. This pressure was monitored on gage 8. Hand valve 10 was closed and gage 8 was monitored for 5 minutes 3.2.13 for indications of leakage from the actuator signal port. Hand valves 9 and 10 were opened, regulator 6 was closed to zero 3.2.14 outlet pressure, and the system was bled to zero psig. The specimen was removed from the installation and installed as 3.2.15 shown in figure 3-2 using the equipment listed in table 3-1. All connections were tight, all gages were installed and operating properly, and all hand valves and regulator 6 were closed. 3.2.16 Hand valve 3 was opened and the 1800 psig supply pressure was monitored on gage 5.

pressure of 20 psig was indicated on gage 8.

3.2.17

Hand valve 10 was opened and regulator 6 was adjusted until a

- 3.2.18 Hand valve 10 was closed and the vacuum jacket was checked for leakage for 5 minutes by monitoring gage 8. 3.2.19 The system was bled to zero psig by closing regulator 6 to zero outlet pressure and opening hand valves 9 and 10. 3.2.20 The specimen was removed from the installation and installed as shown in figure 3-3 using the equipment listed in table 3-1. All connections were tight, all gages were installed and working properly, and all hand valves, except hand valve 21, were closed. Regulators 6 and 17 were adjusted to zero outlet pressure. 3.2.21 Hand valve 3 was opened and the 1800 psig supply pressure was monitored on gage 5. Regulator 6 was adjusted until gage 8 indicated 100 psig pressure 3.2.22 in the interior of the specimen. 3.2.23 Hand valve 13 was opened and the 1800 psig, pure helium supply pressure was monitored on gage 16. Regulator 17 was adjusted to provide a low pressure, continuous 3.2.24 He purge of plastic bag 22. The vacuum jacket was evacuated to  $1 \times 10^{-7}$  microns by operating 3.2.25 the vacuum pump on helium mass spectrometer 20. This pump continued operation throughout the remainder of the test. The vacuum jacekt was monitored for leakage for 5 minutes by 3.2.26 observing the indicator of helium mass spectrometer 20. The low pressure purge and 100 psig internal pressure at the specimen were maintained throughout this period. 3.2.27 The system was vented to zero psig by closing regulators 6 and 17 and opening hand valves 9 and 14.
- 3.3 TEST\_RESULTS

3.2.28

The specimen did not leak during any of the tests and there was no evidence of distortion.

The specimen was removed from the installation and inspected.

# 3.4 TEST DATA

The data presented in table 3-2 were recorded during the test.

Table 3-1. Proof Pressure Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Specimen	Annin Company	1760	60609-1-1	Globe valve,
2	Pressure Source	Air Products	NA	NA	le-inch, 100-psig 0-to 2200-psig
2	Hand Valve	Air Products	3550	•	GN <sub>2</sub>
3 4	Filter	Linde	NA NA	NA	10 micron; part
4	111001	Billido			of regulator 6
5	Pressure Gage	Linde	27156	NA	C-to 3500-psig
6	Regulator	Linde	8956	NA	O-to 350C-psig - inlet C-to 2500-psig -
					outlet
. 7	Pressure Gage	Linde	26Y23	NA	0=to 2500-psig
8	Pressure Gage	Heise	NASA 0813	014226	0-to 160-psig 0.1% FS
9	Hand Valve	Robbins Aviation,	SSKG-25C-	NA	Cal date 8-20-66 $\frac{1}{4}$ -inch
10	Hand Valve	Robbins Aviation, Inc.	SSKG-250- 4T	NA	1/4-inch
11	Pressure Source	Air Products	NA ·	NA	C-to 180C-psig He
12	Cap	'	NA	NA	$\frac{1}{4}$ -inch, AN
13	Hand Valve	Robbins Aviation,		NA	$\frac{1}{4}$ -inch
14	Hand Valve	Inc. Robbins Aviation, Inc.	4T   SSKG-250-   4T	NA	1/4-inch
15	Hand Valve	Robbins Aviation,		NA	1/4-inch
16	Pressure Gage	Linde	27Y 56	NA	0-to 3500-psig
17	Regulator	Linde	8956	NA	O-to 3500-psig inlet O-to 2500-psig outle
18	Pressure Gage	Linde	26¥23	NA	O-to 2500-psig
19	Pressure Source	Air Products	NA	NA	0-to 1800-psig 90% N <sub>2</sub> -10% He
20	Helium Mass Spectrometer	Veeco	MS-9AB	08 <b>-113</b> 01 <i>2</i> 4 <b>7</b> 0	Cal date 8-10-66
21	Vacuum Valve	Cryolab	VO1-84-	NA	½-inch
22	Plastic Pos		1Z2 NA	NA	
23	Plastic Bag Hand Valve	Robbins Aviation, Inc.	I B	NA NA	$\frac{1}{4}$ -inch
		1110.			

Table 3-2. Proof Pressure Test Data

Specimen	Paragraph Number	Test Object	Media	Pressure (psig)	Time (min)	Leakage
1	3.1.1	Valve	GN <sub>2</sub>	150	5	None
1	3.1.2	Actuator	GN <sub>2</sub>	75	5	None
1	3.1.3	Domotor	GN <sub>2</sub>	22	5	None
. 1	3.1.4	Vacuum Jacket	GN <sub>2</sub>	20	5	None
1	3.1.6	Valve Vacuum Jacket	90% GN <sub>2</sub> 10% He <sup>2</sup>	100 psig .05 microns	NA	None*
2	3.1.1	Valve	GN <sub>2</sub>	150	5	None
2	3.1.2	Actuator	GN <sub>2</sub>	75	5	None
2	3.1.3	Domotor	GN <sub>2</sub>	22	5	None
2	3.1.4	Vacuum Jacket	GN <sub>2</sub>	20	5	None
2	3.1.6	Valve Vacuum Jacket	90% GN <sub>2</sub> 10% He	100 psig .05 microns	NA	None *
3	3.1.1	Valve	GN <sub>2</sub>	150	5	None
3	3.1.2	Actuator	GN <sub>2</sub>	75	5	None
3	3.1.3	Domotor	GN <sub>2</sub>	22	5	None
3	3.1.4	Vacuum Jacket	GN <sub>2</sub>	20	5	None
3	3.1.6	Valve Vacuum Jacket	90% GN <sub>2</sub> 10% He	100 psig .05 microns	NA	None *

<sup>\*</sup> Minimum reading 6.4 x 10<sup>-10</sup> scc/sec ±10%.

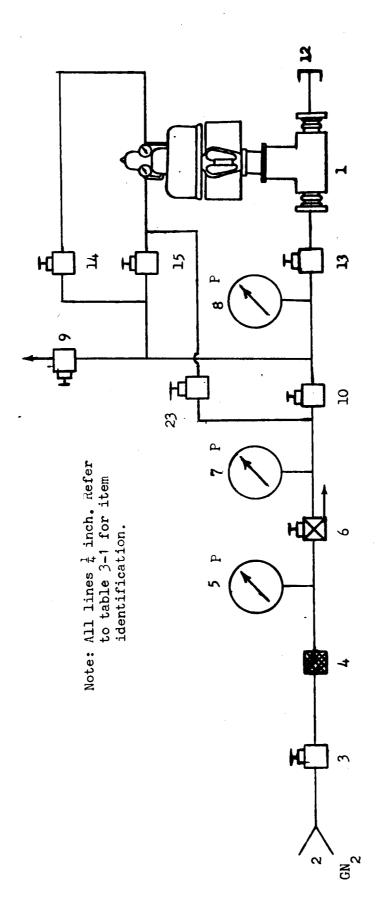


Figure 3-1 Proof Pressure Test Schematic (Valve and Domotor)

нĮ 2

Note: All lines ‡ inch. Refer to table 3-1 for item identification.

Figure 3-2. Proof Pressure Test Schematic (Vacuum Jacket)

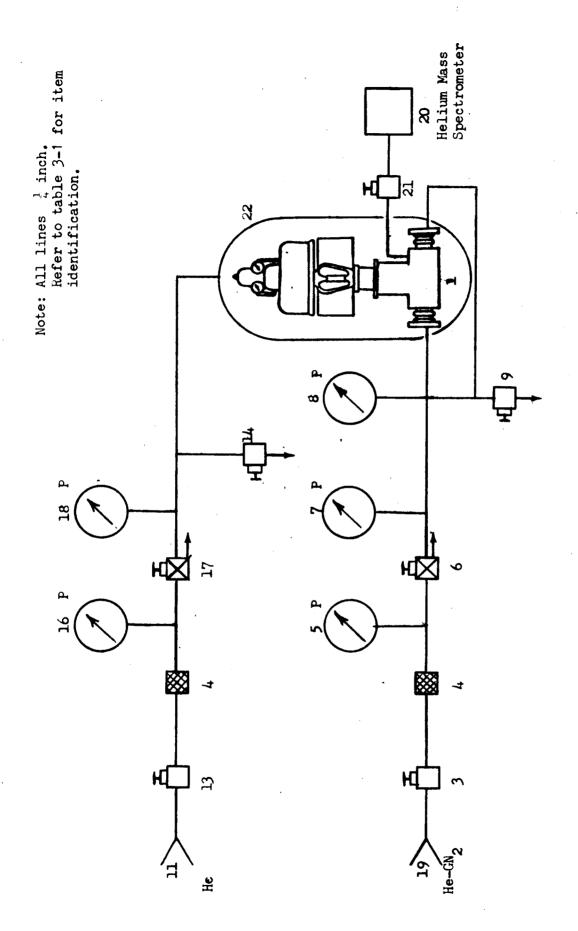


Figure 3-3. Vacuum Leak Test Schematic

# SECTION IV

# FUNCTIONAL TEST

4.1	TEST REQUIREMENTS
4.1.1	GENERAL
4.1.1.1	Position Indicating Switches. The position indicating switches shall be monitored during each step of the functional test.
4.1.1.2	Vacuum Jacket. During all phases of the functional test, the vacuum jacket shall be evacuated to less than 10 microns of mercury absolute and monitored for pressure rise and temperature drop.
4.1.1.3	External Leakage. The specimen shall be checked for external leakage during the functional test.
4.1.2	CYCLING
	The specimen shall be pneumatically cycled by the actuator with ${\rm GN}_2$ from the closed to the open to the closed position 10 times. This shall be done during the initial functional test only.
4.1.3	VALVE INTERNAL SEAT LEAKAGE
4.1.3.1	The specimen shall be held in the closed position by pressurizing the actuator with 20 psig $GN_2$ and the upstream side of the specimen with 100-psig He or $GH_2$ at -423°F. The valve seat shall be checked for leakage for 5 minutes. Maximum allowable leakage is 15 sccm.
4.1.3.2	The procedures described in 4.1.3.1 shall be repeated, except that the pressure shall be applied to the downstream side with 25-psig He or CH <sub>2</sub> at -423°F.
4.1.4	LOSS OF ACTUATOR PRESSURE
	Procedures described in 4.1.3.1 and 4.1.3.2 shall be repeated, except that no pressure shall be applied to the actuator signal or supply ports.
4.1.5	INTERNAL SEAT LEAKAGE
	Procedures described in 4.1.3.1 and 4.1.3.2 shall be repeated, except that the actuator supply pressure shall be 50 psig.

#### 4.1.6 ACTUATOR SIGNAL

The specimen shall be pressurized to 100 psig using LH<sub>2</sub> as the pressure medium. The actuator supply shall be pressurized to 50 psig using  $GN_2$  as the pressure medium. The actuator signal port shall be pressurized with  $GN_2$  and the pressure varied from 3 to 15 psig to open the valve 25, 50, 75, and 100 per cent. The specimen shall be closed by reducing the signal pressure from 15 psig to 3 psig, and the time required to close shall be recorded. The specimen shall be opened by applying 15 psig to the actuator signal, and the opening time shall be recorded.

#### 4.1.7 ACTUATOR SIGNAL

Procedures described in 4.1.6 shall be repeated, except that the actuator supply pressure shall be 20 psig.

# 4.2 TEST PROCEDURE

#### 4.2.1 GENERAL

- 4.2.1.1 The position indicating switches and the Bourns position indicators were monitored throughout the functional test on recording oscillograph 38.
- The vacuum jacket was monitored during the functional test by observing vacuum thermocouple 34 and skin thermometer 33.
- 4.2.1.3 A leak detection solution was used to check the external surface and valve stem of the specimens for leakage during all phases of the functional test.
- 4.2.1.4 A continuous 5-psig,  $GN_2$  purge was placed on the Bourns position indicator throughout the functional test.

#### 4.2.2. CYCLING

- 4.2.2.1 The specimen was installed as shown in figures 4-1A and 4-2, using the equipment listed in table 4-1. It was determined all connections were tight, all gages were installed and operating properly, and that all valves were closed.
- 4.2.2.2 Valve 3 was opened and a pressure of 3000 psig was observed on gages 4, 5, and 6.
- 4.2.2.3 Regulator 7 was adjusted until a pressure of 15 psig was observed on gage 26.
- 4.2.2.4 Regulator 8 was adjusted until a pressure of 25 psig was observed on gage 27.
- 4.2.2.5 Regulator 9 was adjusted until a pressure of 100 psig was observed on gage 28.

- Valve 39 was opened and the specimen was allowed to come to the fully opened position. Valve 39 was then moved to the vent position and the specimen was allowed to close. This procedure was performed 10 times, and the resistance of the Bourns indicator was measured. All data were recorded.
- 4.2.3 UPSTREAM PRESSURIZATION
- Valves 13 and 14 were opened and the  $LH_2$  vent stack was purged with  $GN_2$ .
- 4.2.3.2 Valves 13 and 14 were closed.
- 4.2.3.3 The pressure in LH<sub>2</sub> dewar container 42 was reduced to 50 psig. This pressure was monitored on gage 20. Control of the pressure venting was achieved by opening hand valve 18, venting dewar container 42 through the vent stack, and then closing hand valve 18.
- 4.2.3.4 LH<sub>2</sub> dewar container 42 was repressurized to 100 psig by opening valves 24 and 19 and adjusting regulator 23.
- 4.2.3.5 Valves 13, 14, 15, 17, and 39, and back pressure regulator 38 were opened, and the system was purged with  $GN_2$ . Back pressure regulator 38, and valves 17, 15, 13, and 14 were closed in that order, and 100-psig  $GN_2$  was trapped in the system. The system was checked for leakage by monitoring pressure transducers 30 and 31.
- 4.2.3.6 Valve 17 was opened, the pressure was bled to 15 psig, and valve 17 was closed. Valve 16 was opened momentarily and hydrogen was introduced into the system. A leak check was performed.
- Valves 16 and 17 were opened and hydrogen was flowed through the system until thermometer 32 indicated a temperature of -423°F.

  When the proper temperature was obtained, valve 39 was moved to the vent position and the specimen closed.
- 4.2.3.8 Venting regulator 49 was adjusted at 2.9 psig as indicated on gage 29.
- 4.2.3.9 Leak detector 41 was installed as shown in figure 4-1B and valve 17 was closed.
- 4.2.4 VALVE INTERNAL SEAT LEAKAGE TEST
- Regulator 8 was adjusted until an actuator pressure of 20 psig was observed on gage 27.
- 4.2.4.2 Venting regulator 49 was adjusted until a signal pressure of 29 psig (+0.0, -0.1 psig) was observed on gage 29.

- 4.2.4.3 A 5 minute leak check of the specimen was performed by measuring displacement of fluid. All data was recorded.
- 4.2.5 LOSS OF ACTUATOR PRESSURE TEST

The procedures described in 4.2.3.7 through 4.2.4.3 was repeated except a signal pressure and actuator pressure of zero psig were used.

4.2.6 INTERNAL SEAT LEAKAGE TEST

The test described in paragraphs 4.2.3.7 through 4.2.4.3. was repeated except an actuator pressure of 50 psig was used.

4.2.7 ACTUATOR SIGNAL PRESSURE TEST

Back pressure regulator 38 was adjusted to 20 psi below dewar container pressure.

- Valve 16 was opened and valve 39 was adjusted until the mechanical travel scale of the specimen indicated the specimen was \(\frac{1}{4}\) open.

  All data were recorded.
- 4.2.7.2 The procedure described in 4.2.7.1 was repeated for valve positions of 1/2, 3/4, and fully open.
- Valve 39 was moved to the vent position, then to the open position, and back to the vent position. The time required to open and close the specimen was recorded.
- 4.2.7.4 Regulator 8 was adjusted until a pressure of 20 psig was observed. on gage 27.
- 4.2.7.5 The procedures described in 4.2.7.1 through 4.2.7.3 were repeated.
- 4.2.8 SYSTEM PURGE
- 4.2.8.1 Valve 16 was closed, and back pressure regulator 38 and valves 17 and 39 were opened.
- 4.2.8.2 Valves 13 and 15 were opened and the system was purged with GN<sub>2</sub>.
- Valves 13, 15, and 17 were closed, back pressure regulator 38 was placed in the operating position, and valve 39 was placed in the vent position.
- 4.2.9 DOWNSTREAM PRESSURIZATION
- 4.2.9.1 The specimen was removed from the installation, turned 180 degrees, and reinstalled as shown in figure 4-1A.

- 4.2.9.2 The upstream pressurization procedure, paragraph 4.2.3, was repeated except LH<sub>2</sub> dewar container 42 was depressurized to 15 psig, and then repressurized with He to 25 psig.
- 4.2.10 DOWNSTREAM LEAKAGE TESTS
- 4.2.10.1 The tests described in paragraphs 4.2.4, 4.2.5, and 4.2.6 were repeated.
- 4.2.11 The purge described in paragraph 4.2.8 was performed.
- 4.3 <u>TEST RESULTS</u>
- 4.3.1 **SPECIMEN 1**
- 4.3.1.1 The specimen successfully met the functional test requirements when the actuator was pressurized to 50 psig.
- 4.3.1.2 The specimen failed to operate with the upstream side pressurized to 100 psig with GH<sub>2</sub> at -418°F and the actuator pressurized to 20 psig.
- 4.3.1.3 The specimen failed to seat with the downstream side pressurized to 25 psig with GH<sub>2</sub> at -418°F and the actuator pressurized to 20 psig. The specimen cracked at 2.8 psig signal pressure and did not seat until the signal pressure was lowered to 2.5 psig.
- 4.3.2 SPECIMEN 2

The specimen successfully completed the functional test requirements.

4.3.3 **SPECIMEN 3** 

The specimen failed to meet the functional test requirements. The specimen cracked at 2.7 psig signal pressure and seated at 2.6 psig signal pressure.

- 4.3.3.1 A second function test was conducted using a minimum actuator pressure of 25 psig and a minimum signal pressure of 2.7 psig.

  The specimen successfully completed the functional test requirements.
- 4.4 TEST DATA

The data recorded during the functional test are shown in tables 4-3 through 4-5.

Table 4-1. Functional Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Specimen	Annin Company	1760	NA .	Globe valve, -inch, 100-psig
2	Pressure Source		NA	NA	3000-psig GN <sub>2</sub>
3	Hand Valve	Hoke	PY273	NA	inch
4	Pressure Gage	Union Carbide	79172-1	NA	0-to 100-psig
	Pressure Gage	Union Carbide	29172-1	NA	C-to 100-psig
5	Pressure Gage	Union Carbide	29177-1	NA.	O-to 100 psig
7	Pressure Regulator	,	SR431	859279	O-to 50-psig
8	Pressure Regulator		SR431	859273	0-to 150-psig
9	Pressure Regulator		SR431	859203	0-to 150-psig
lío	Pressure Gage	Victor	22660-1	NA	C-to 4000-psig
11	Pressure Gage	Union Carbide	29177-1	NA	0-to 400-psig
12	Pressure Gage	Victor	22660-1	NA	0-to 4000-psig
13	Pneumatic Valve	Hoke	30201-1	NA	½-inch
14	Pneumatic Valve	Hoke	30201-1	NA	$\frac{1}{h}$ -inch
15	Pneumatic Valve	Hoke	30201-1	NA	inch
16	Pneumatic Valve	Hoke	DR294AJ	NA	inch
17	Pneumatic Valve	Hoke	30201-1	NA NA	inch
18	Hand Valve	Control Component	\$304-SS	NA	$\frac{1}{4}$ -inch
19	Hand Valve	Powell	NA	8157	,
.2C	Pressure Gage	US Gauge Company	10895	NA	O-to 30-VAC C-to 300-psig
			:		
	•				±0.5% FS
			İ		Cal date 10-7-66
21	Pressure Gage	Supergauge	-B-		0-to 160-psig
		·		13	±0.5% FS
22	Pressure Gage	Victor	<b>3</b> 0 <b>-</b> 205 <b>-</b> 202	NA	0-to 4000-psig
2 <b>3</b>	Pressure Regulator	Victor	701N	<b>8</b> 699 <b>S</b> 4	0-to 250-psig
24	Hand Valve	Airco	NA	ŇÁ	
25	Pressure Source	Airco Helium Bottle	NA	NA	1800-psig H <b>e</b>
26	Pressure Gage	Duragauge	-B-		0-to 30-psig
1~0	11030410 0460	2 44 45 4480	-		+0.5% FS
			į		Cal date 10-7-66
27	Pressure Gage	   Heise	-B-		0-to 160-psig
~'	Tressure dage	110136	-b-	77-17700	± 0.1 % FS
			1		_
			l		Cal date 10-7-66
28	Pressure Gage	Supergauge	-B-	106-1119E	0-to 160-psig
ľ			!		± 0.5 % FS
			1		Cal date 10-7-66
29	Pressure Gage	   Heise	-B-	95-1376B	0-to 60-psig
~/	1.1000410 0450		1	1, 2, 35	Cal date 10-7-66
<u> </u>	<u> </u>	<u> </u>	L	<del></del>	·

Table 4-1. Functional Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
<b>3</b> 0	Pressure Transduce	r CEC	NA	NA	0-to 100-psig + 0.5% FS
					Cal date 10-7-66
31	Pressure Transduce	CEC	NA	018170	0-to 100-psig + 0.5% FS
					cal date 10-7-66
<b>3</b> 2	Resistance Thermometer	Rosemount	150MA32	6454	-415 to -430 + 0.5°F
33	Thermocouple	Copper - Co Constantan	NA	NA	<u>+</u> 1°F
34	Vacuum Thermo-	NRC Equipment Corporation	Type 0521	NA	+10% accuracy Cal date 9-15-66
35	Vacuum Valve	Cryolab	SV1 84-SW-2	NA	inch
36	Vacuum Pump	Welch	010587	9863-97	
37	Check Valve	Lukenheiman	2144	NA	2-inch, vertical
38	Back Pressure Regulator	Fisher	NA	4140132	1-inch
39	Hand Valve	Republic Mfg.	NA .	424	$\frac{1}{4}$ -inch
40	Recording Oscillograph	CEC	NA	01 <b>25</b> 92	Cal date 6-27-67
41	Leak Detector	CCSD	NA NA	NA	
42	175 Liter Dewar Container	Cryenco	195-L	1158-19	LH <sub>2</sub>
43	Hand Valve	Robbins	SSKG25C	NA	6000 psi
44	Hand Valve	Robbins	SSKG250	NA	6000 psi
45	Hand Valve	Robbins	SSKG250	NA.	6000 psi
46	Hand Valve	Robbins	SSKG250	NA	6000 psi
47	Solenoid Valve	Marotta	MV74	NA	3000 psig
48	Timer	Wilson	Mod.#1	NA	Repeat cycle
49	Venting Regulator		26-1610 -43-031	2505	O-to 100-psig
<b>5</b> C	Environmental Chamber	CCSD	NA	NA	-20 to +200°F
	:				

Table 4-2. Initial Functional Test Data

GH <sub>2</sub> -418 78 25 20 2.5 psig valve 1/8 open	78 23 100 0 0 0	-418 78 23 100 C C C C	GH <sub>2</sub> -418 78 23 100 0 20 2.9 C C 1/2 3/4	In Out Act Sig Int Ext Open Close	Leakage sccm Swit
---	-----------------	------------------------	---	-----------------------------------	----------------------

\* Interim report number GSE 64

Table 4-3. Initial Functional Test Data

			·				rest	DATA	TEST DATA SHEET					Sp	Specimen No.	No.	2	ŀ
	Phoen	Media		Temperature	Vacuum	Pre:	Pressure Pair	Domotor Pressure Psig	tor sure	Leakag sccm	Leakage sccm	Swit	Switches	In	Indicator	Į.	Stem Travel Secs.	in re]
1	0000		Inner	Outer		In		Act	Sig	Int	Ext	Open	Слозе	Open	Res Ohms	Sig Psi	Open	Open Close
	Int Seat	GH <sub>2</sub>	-418.	69.1	10	100	0	8 .	2.9	6.8	0	ok	ok	0 1/4 3/4 Full	4769 62 62 62	2.9 6.0 9.3 11.5	12.9	0*9
I	Loss of Psi	CH2	-418	19	10	100	0	0	0	3.0	0	성	٥k					
	Int Seat	GH <sub>2</sub>	-418	69.1	10	100	0	50	2.9	0	0	ok	ok	0 1/4 3/4 Eull	4769	2.9 5.0 8.5 11.2 15.0	3.4	6.6
	Int Seat	CH <sub>2</sub>	817-	.82	10	. 0	25	80	2.9	6.8	-	,	ok					
	Loss of Psi	СН2	-418	81.	10	0	25	0	0	5.0			ok			·	·	
	Int Seat	СН <sub>2</sub>	817-	82.4	10	0	25	50	2.9	2.910.2			ok					

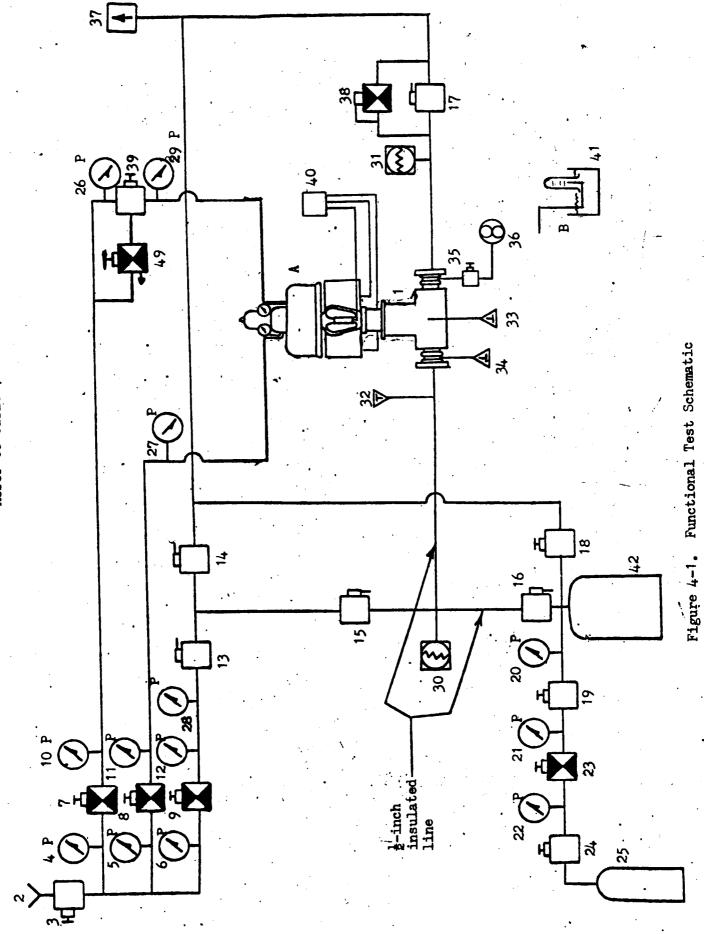
Table 4-4. Initial Functional Test Data

Leakage Swit scom Int Ext Open Valve cracked C C C Ok C C C C C C C C C C C C C C C	Leakage sccm Int Ext C Valve crac C C C C C C C C C C C C C C C C C C C	TEST DA	Media Temperature Vacuum Pressure	microns Paig	GH <sub>2</sub> -418 73 15 100 C	GH <sub>2</sub> -413 73 15 1CC C		Int Seat GH <sub>2</sub> -418 73 15 100 0 Leakage		Seat GH2 -418 73 15 0 25	Psi GH2 -418 73 15 0 25	Int Seat Leakage GH <sub>2</sub> -418 73 15 0 25
Leakage Swit sccm Int Ext Open Valve cracked C C C C C C C C C C C C C C C C C C C	Leakage   Switches   Switches   Switches   Open   Close   Open   Close   Open   Open   Close   Open   Ope	TEST DATA SHEET	Domotor Pressure	Act Sig			2.9					
1 +	tches ok   1/4   1		1	Int Ext	Valve		Valve	0		-		*
			Switches			ok	acked	Ą				
			Stem Travel Secs.	Close	run			<u> </u>	_			

\* Valve cracked at 2.6 psig pressure, see Interim Report number GSE 69.

Table 4-5. Initial Functional Test Data

Specimen No. 3	tor	Open Close Open Ohms Psi Open Close	ok ok 1/2 5.9 5.9 5.4 3/4 215 15.6 Full 215 15.6	ok	ok ok 1/2 8.8 6.0 5.7 8.8 8.0 5.7 8.1	ok	ok	ok
	Leakago sccm	Int Ext	0	Ö	O	0	0	0
TEST DATA SHEET	Domotor Pressure	Sig	2.7 0	0	2.7 0	2.7 0	0	2.7
T DATA		دد	25	0	50	5 25	0	20
TES	Pressure	In Out	100 0	0 001	000	0 25	0 25	0 25
	Vacuum	mcrons		7	2	2	2	2
			. 02	20	89	68.	- 89	89
	Temperature	Inner	-420	-420	74.20	-420	-420	-420
	Media	<u> </u>	GH2	GH <sub>2</sub>	LH2	LH2	LH2	LH2
		Phase	Int Seat Leakage	Loss of Psi	Int Seat Leakage	Int Seat Leakage	Loss of Psi	Int Seat Leakage
			ъą	<b>∞</b> H	<b>K I                                   </b>	DOZZ	SEC	X>M



4-12

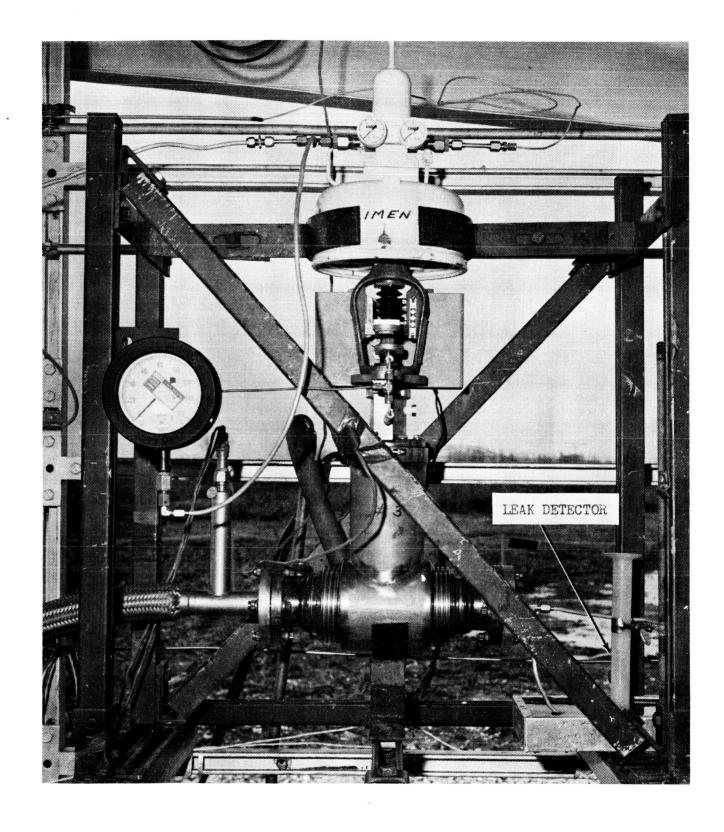


Figure 4-2. Functional Test Setup

#### SECTION V

#### TEMPERATURE SHOCK TEST

#### 5.1 TEST REQUIREMENTS

#### 5.1.1 PURGE

The purge described in paragraph 4.2.9, shall be conducted before and after the introduction of hydrogen into the system.

## 5.1.2 INTERNAL SEAT LEAKAGE

The procedures described in paragraph 4.1.1 shall be repeated except that the pressure shall be applied to the downstream side of the valve with 25-psig He at 125°F.

#### 5.1.3 LOSS OF ACTUATOR PRESSURE

The procedures described in paragraph 4.1.2 shall be repeated except that no pressure shall be applied to the actuator supply or signal ports.

### 5.1.4 INTERNAL SEAT LEAKAGE

The specimen shall be stabilized at a temperature of  $125^{\circ}F$ . Using GH<sub>2</sub> at 25 and 100 psig and  $125^{\circ}F$  as the pressure medium for the specimen's valve body and GN<sub>2</sub> at 50 psig and  $125^{\circ}F$  as the pressure medium for the actuator. The downstream and upstream internal seat leakage tests, described in paragraph 4.2.6, shall be conducted.

# 5.1.5 LOSS OF ACTUATOR PRESSURE

The procedures described in paragraph 4.2.5 shall be repeated except that no pressure shall be applied to the actuator supply and actuator signal ports.

#### 5.1.6 SHOCK

The specimen shall be cooled within 2 minutes by flowing  $GH_2$  and then  $IH_2$  through the specimen.

#### 5.1.7 ACTUATOR SIGNAL PRESSURE

The procedures described in paragraph 4.2.7 shall be performed.

# 5.2 TEST PROCEDURE

5.2.1 Specimens 2 and 3 were installed as shown in figures 5-1 and 5-2 using the equipment listed in table 5-1. It was determined

that all connections were tight, gages were installed and operating properly, and all valves are closed.

- 5.2.2 The temperature of environmental chamber 50 was raised to 125°F and stabilized at that temperature.
- 5.2.3 DOWNSTREAM PRESSURIZATION
- 5.2.3.1 Regulator 8 was adjusted until a pressure of 50 psig was observed on gage 27.
- 5.2.3.2 The procedures described in paragraphs 4.2.2.3 through 4.2.2.5 and 4.2.3.1 through 4.2.3.4 were performed except LH<sub>2</sub> dewar container 42 was vented to 15 psig and repressurized with He to 25 psig.
- 5.2.3.3 Valves 13, 14, 15, 17, 39, 43, 44, 45, and 46, and back pressure regulator 38 were opened and the system was purged with GN<sub>2</sub>.
- 5.2.3.4 Back pressure regulator 38 and valves 17, 15, 13, and 14 were closed in that order and 100-psig GN<sub>2</sub> was trapped in the system. The system was checked for leakage by monitoring transducers 30 and 31.
- 5.2.3.5 Valve 17 was opened momentarily and the pressure was bled to 15 psig. Valve 16 was opened and closed and hydrogen was introduced into the system. A leak check was performed.
- 5.2.3.6 Valve 17 was reopened momentarily and the pressure was bled to 20 psig.
- 5.2.3.7 Valve 45 was closed and valve 39 was moved to the vent position.
- 5.2.3.8 Valve 16 was opened momentarily and the specimen was pressurized with GH<sub>2</sub> at 25 psig. The temperature of the hydrogen was allowed to rise to 125°F.
- 5.2.3.9 Valve 17 was opened and leak detector 41 was connected as shown in figure 5-1B. Valve 17 was closed.
- 5.2.4 INTERNAL SEAT LEAKAGE TEST, SPECIMEN NUMBER 2
- 5.2.4.1 The specimen was checked for leakage by monitoring leak detector 41 for 5 minutes. The data were recorded.
- 5.2.5 LOSS OF ACTUATOR PRESSURE TEST, SPECIMEN NUMBER 2
- 5.2.5.1 Valve 44 was closed and valve 39 was moved to the vent position.

5.2.5.2 The specimen was checked for leakage by monitoring leak detector 41 for 5 minutes. 5.2.6 INTERNAL SEAT LEAKAGE TEST, SPECIMEN NUMBER 3 5.2.6.1 Valves 44 and 45 were opened, and specimen number 3 was closed. Valve 45 was closed after the specimen closed. 5.2.6.2 Regulator 8 was adjusted until a pressure of 50 psig was observed on gage 27. Valve 39 and specimen number 2 were opened, valve 46 was 5.2.6.3 closed, and valve 39 was moved to the vent position. Valve 45 was opened. 5.2.6.4 The specimen was checked for leakage by monitoring leak detector 41 for 5 minutes. The data were recorded. 5.2.7 LOSS OF ACTUATOR PRESSURE TEST, SPECIMEN NUMBER 3 5.2.7.1 Valve 43 was closed. 5.2.7.2 The specimen was checked for leakage by monitoring leak detector 41 for 5 minutes. The data were recorded. 5.2.8 SYSTEM PURGE Leak detector 41 was removed and valves 43 and 46 were opened. 5.2.8.1 5.2.8.2 The purge procedure described in paragraph 4.2.8 was performed. UPSTREAM PRESSURIZATION 5.2.9 5.2.9.1 The specimens were removed from the installation, turned 180 degrees, and reinstalled as shown in figure 5-1. The downstream pressurization procedure, paragraph 5.2.3, was 5.2.9.2 performed except LH2 dewar container 42 was pressurized with He to 100 psig. UPSTREAM LEAKAGE TESTS, SPECIMENS NUMBERS 2 AND 3 5.2.10 The tests described in paragraphs 5.2.3.9, 5.2.4, 5.2.5, 5.2.6, and 5.2.7 were performed on specimens 2 and 3 at 100 psig pressure. 5.2.11 TEMPERATURE SHOCK

5.2.11.1

Leak detector 41 was removed and valves 43 and 46 were opened.

- 5.2.11.2 Regulator 8 was adjusted until a pressure of 50 psig was observed on gage 27.
- 5.2.11.3 Valves 17, 39, and 16 were opened in that order and IH<sub>2</sub> flowed throught the specimens until thermometer 32 indicated a temperature of -423°F. Valves 17, and 46 were then closed, and valve 39 was moved to the vent position.
- 5.2.12 ACTUATOR SIGNAL PRESSURE TEST, SPECIMEN NUMBER 3

  Regulator 8 was adjusted to 50 psig and the tests described in paragraphs 4.2.7 through 4.2.7.3 were performed on specimen 3.
- 5.2.13 ACTUATOR SIGNAL PRESSURE TESTS, SPECIMEN NUMBER 2
- 5.2.13.1 Regulator 8 was adjusted until 50 psig was observed on gage 27. Valve 46 was opened and specimen 2 was closed. Valve 46 was closed.
- 5.2.13.2 Valve 39 and specimen 3 were opened.
- 5.2.13.3 Valve 45 was closed, valve 39 was moved to the vent position, and valve 46 was opened.
- 5.2.13.4 The tests described in paragraphs 4.2.7.1 through 4.2.7.3 were performed on specimen 2.
- 5.2.14 PURGE

Valve 45 was opened and the purge procedure described in paragraph 4.2.8 was performed.

#### 5.3 TEST RESULTS

Specimens number 2 and number 3 successfully completed the requirements of the temperature shock test except the minimum signal pressure requirements for specimen number 3 was out of tolerance. An extra test was performed on specimen number 3 to determine the minimum actuator pressure. Minimum actuator pressure was determined to be 25 psig.

#### 5.4 TEST DATA

The data recorded during the temperature shock test are presented in tables 5-2 and 5-3.

Table 5-1. Temperature Shock Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Specimen	Annin Company	1760	NA	
2	Pressure Source		NA NA	NA	3000 psig GN <sub>2</sub>
3	Hand Valve	Hoke	PY273	NA.	
4	Pressure Gage	Union Carbine	29172-1	NA	0-to 100-psig
5	Pressure Gage	Union Carbine	29172-1	NA	0-to 100-psig
6	Pressure Gage	Union Carbine	29177-1	NA	0-to 100-psig
7	Pressure Regulator	Victor	SR431	859279	O-to 50-psig
8	Pressure Regulator	Victor	SR431	859273	0-to 150-psig
9	Pressure Regulator	Victor	SR431	859203	0-to 150-psig
10	Pressure Gage	Victor	22660-1	NA	0-to 1000-psig
11	Pressure Gage	Union Carbine	29172-1	NA	0-to 100-psig
12	Pressure Gage	Victor	22660-1	NA	0-to 4000-psig
13	Pneumatic Valve	Hoke	30201-i	NA	<del>1</del> -inch
14	Pneumatic Valve	Hoke	30201-1	NA	‡-inch
15	Pneumatic Valve	Hoke	30201-1	NA	<del>1</del> -inch
16	Pneumatic Valve	Hoke	OR294AJ	NA	Hand Valve
17	Pneumatic Valve	Hoke	30201-1	NA	<del>1</del> -inch
18	Hand Valve	Control Conponent	<b>s</b> 30455	NA	<del>1</del> -inch
19	Hand Valve	Powell	NA	8157	
20	Pressure Gage	US Gauge Company	10895	NA	0-te 300-psig ± 0.5 % FS
21	Pressure Gage	Super Gauge	-B-	106-1121 B	0-to 160-psig + 0.5 % FS  Cal date 10/8/66

Table 5-1. Temperature Shock Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
22	Pressure Gage	Victor	30-205- 203	NA	O-to 1000-psig
23	Pressure Regulator	Victor	701N	869954	O-to 250-psig Ref
24	Hand Valve	Airco	NA	NA	
25	Pressure Source	Airco	NA	NA	1800-psig He
26	Pressure Gage	Duragauge	-B-	95-1560- B	0-to 30-psig + 0.5 % FS
27	Pressure Gage	Heise	-B-	951398- B	Cal date 10-7-66 0-to 160-psig + 0.1 % FS
28	Pressure Gage	Supergage	-B-	1061119- B	Cal date 10-7-66 0-to 160-psig ± 0.5 % FS
29	Pressure Gage	Heise	-B-	95 <b>–</b> 1376- B	Cal date 10-7-66 O-to 60-psig ± 0.1 % FS
30	Pressure Transducer	CEC	NA	018169	Cal date 10-7-66 O-to 60-psig 0.5% FS Cal date
31	Pressure Transducer	CEC	NA	018170	10-7-66 0-to 100-psig 0.5% FS Cal date
32	Resistance Thermometer	Rosemount	150MA32	6454	10-7-66 -415 to -430°F +0.5°F
33	Thermocouple	Copper Constantan	NA	NA	cu, con
34	Vacuum Thermocouple	NRC Equipment	Type 0521	NA:	+10% accuracy Cal date 9-15-66
35	Vacuum Valve	Cryolab	SVI 84-5W2	NA	½-inch
36	Vacuum Pump	Welch	010587	9863-97	
37	Check Valve	Lukenheiman	2144	NA	2-inch, ventical
38	Back Pressure	Fisher	NA NA	4140132	l-inch
39	Hand Valve	Republic Mfg.	NA	424	<del>l=</del> inch
40	Recording Oscillograph	CEC	NA	012592	Cal date 6-27-67
			•		
				,	

Table 5-1. Temperature Shock Test Equipment List

(Sheet 3 of 3)

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
41 42	Leak Detector 175 Liter Dewar	CCSD Cryenco	NA 195–L	NA 1158-19	IH <sub>2</sub>
43 44 45 46 47 48	Hand Valve Hand Valve Hand Valve Hand Valve Solenoid Valve Timer	Robbins Robbins Robbins Robbins Marotta Wilson	55KG250 55KG250 55KG250 55KG250 MU74 Mod #1	NA NA NA NA NA	6000-psi 6000-psi 6000-psi 6000-psi 3000-psig Repeat cycle timer
49	Venting Kegulater Environmental	Tescom	26-1610 42-031 NA	2505 NA	0 to 100-psig
50	Chamber	CCSD			

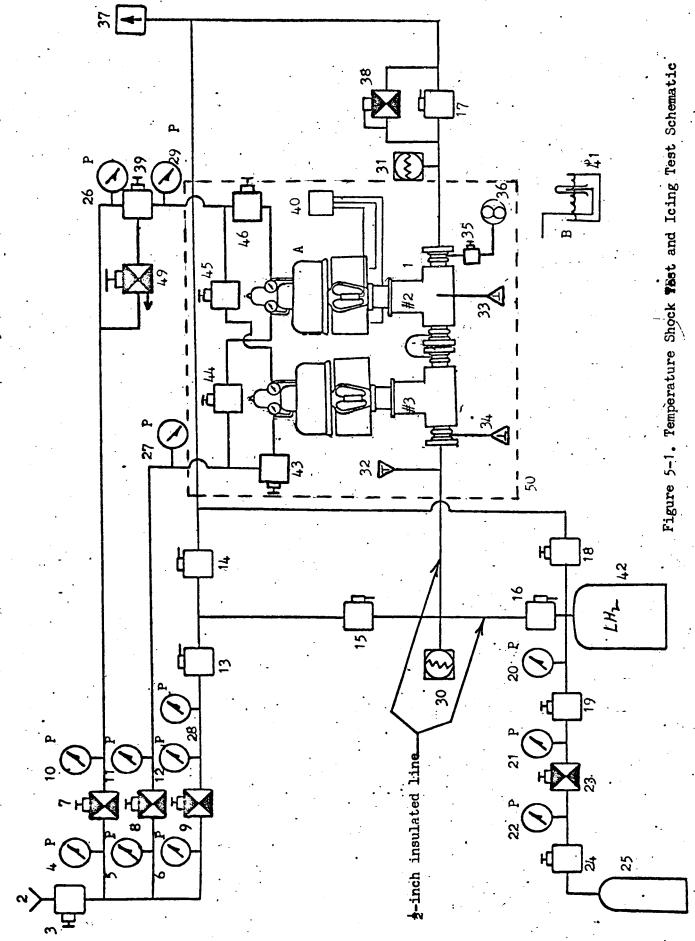
Table 5-2. Temperature Shock Data

Specimen No. 2	Ö	e Open Ohrs Pai Open Close	1/4 1/2 3/4 62	ļ	0 4795 2.9 1/4 5.8 1/2 8.6 5.6 6.1 3/4 10.4 Pull 62 15.0			
	Switches	Open Close	ð		ОК ОК	) M	ÖK	
	Leakago sccm	Int Ext	0	0	1	0	0	
TEST DATA SHEET	Demotor Pressure	Act Sig	50 2.9	0	50 2.9	50 2.9	0	
TEST DA	Pressure P	1.	0	0	100	0 25	0 25	REQUIRED
		microns In	15 100	15 100	001	01	10	NOF R
	Temperature	_	011	011	300		305	
	Tempe	Inner	011	g H	77	86	86	
	Media		GH2	GH2	IH2	GH 2	GH <sub>2</sub>	
		Phase	Internal Seat	Loss of psi	Flow of LH2	Internal Seat Teakare	Loss of psi	
-			D A	<b>တ [</b> ⊢	我で人材	DOZZ	SH	z M < X

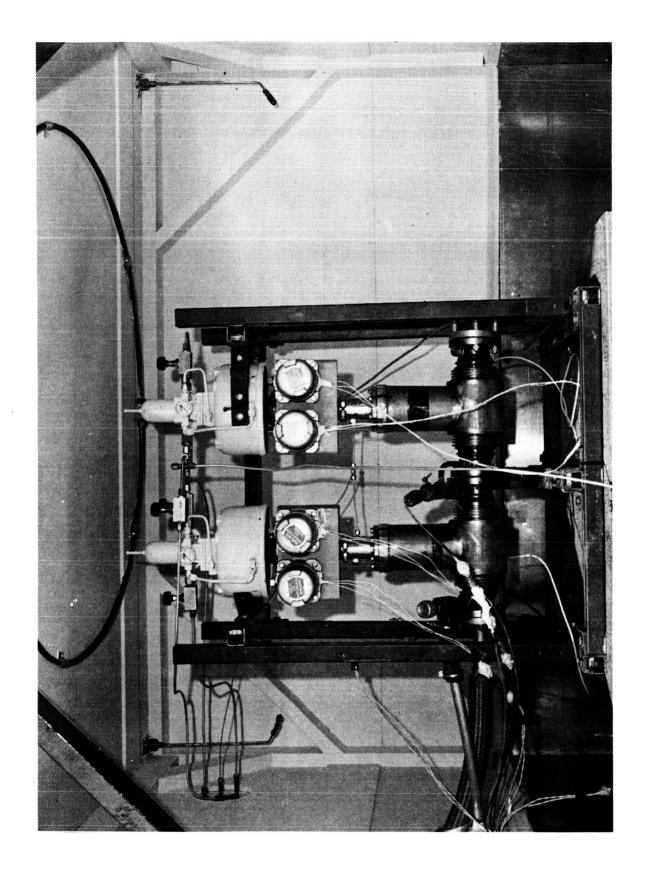
Table 5-3. Temperature Shock Data

<u> </u>						F	EST	TEST DATA SHEET	HEET					Sp	Specimen No.	No.	3	
		Media	Temper	Temporature	Vacuum	Pres	9	Domotor Pressure	or	Leakage	age n	Switches	shes	l H	Indicator	jr.	Stem Travel	Stem ravel
	Phase				microns	Paic.		Ps	I.B.	Traf	+	Great	01036		Res	Sig	3 8	3
			Inner	Outer		4	38	Age	370				2021	۶ĺ	Ohms	P31.	nado Oben	SOTO
		***************************************												1/4			<del></del>	
D &	Seat Leakage	GH <sub>2</sub>	011	011	15	700	0	8	2.7	.2	0		OK	1/2 3/4 Full	·			
S E4	Loss of psi	CH2	112	011	1.5	700	. 0	0	0	2.0	0	-	S X					
K M A									-					0	5187	2.7		1
×	Flow of LH2	LH2	-418	105	15	100	300	50	2.7					1/2 1/2 1/4/10 1	<b>†</b> 7,	8.5 10.5 15.0	7.7	5.6
D																		
S Z O	Internal Seat Leakage	GH2	110	org	15	0	25	50	2.7	0	0		NO.			,		
<b>Ω</b> Ε4	Loss of psi	LH <sub>2</sub>	110	971	15	0	25	0	0	0	0		ğ				·	
<b>러</b> 티 <														0 4	4815	2.7		
< ×	*Flow of IH2	142	-405	105	15	100	0	25	2.7	NA	AN .	χο	ğ	3/4 Full	574	9.2 12.3 Faile	2.3 2.3	5.4
						]												

\*Extra test to determine effects @ 25 psig actuate pressure.



5-10



5-11

#### SECTION VI

#### INSULATION RESISTANCE TEST

# 6.1 TEST REQUIREMENTS

#### 6.1.1 SWITCHES

The insulation resistance shall be 20 megohms at 500 vdc applied for a minimum time of 60 seconds between all non-connected terminals and between all terminals and the case.

#### 6.1.2 BOURNS INDICATOR

The insulation resistance shall be 20 megohms at 500 vdc applied for a minimum time of 60 seconds between all nonconnected terminals and the case.

### 6.2 TEST PROCEDURE

#### 6.2.1 SWITCHES

Using a megohmeter, the electrical resistance between all nonconnected terminals and between all terminals and the case of the actuator position switches was checked. Five hundred (500) vdc was applied for 60 seconds and the resistance in megohms was recorded.

#### 6.2.2 BOURNS INDICATOR

The length of the Bourns indicator output leads was measured in feet and recorded. The electrical resistance between all nonconnected terminals and between all terminals and the case was checked with a megohmeter. Five hundred (500) vdc was applied for 60 seconds and the electrical resistance in megohms was recorded.

# 6.3 TEST RESULTS

6.3.1 The three specimen's successfully completed the requirements of the insulation resistance test.

#### 6.4 TEST DATA

6.4.1 The data recorded during the insuation resistance test are shown in tables 6-2, 6-3 and 6-4.

Table 6-1. Insulation Resistance Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Megohmeter	General Radio Company	1862-C	018415	Cal date 5-20-66 <u>+</u> 5% accuracy
			•		
	, ,		1		

Table 6-2. Insulation Resistance Test Data

Specimen No. 1	REFERENCE TP-RE-FO-1045-2R	ALLOWABLE LIMITS. PAR 6.2.2	KOO wdc annlied for 60	seconds. Minimum resistance	allowed - 20 Megohms				ALLOWABLE LIMITS. PAR 6.2.2	500 vdc applied for 60	seconds. Minimum resistance	allowed - 20 Megohms	
VCE DATA SHEET	SISTANCE HES 5)	CLOSED SWITCH	300	300	300	300	300	þ	RESISTANCE (Ohms)	9967	4961	7	
INSULATION RESISTANCE DATA SHEET	INSULATION RESISTANCE OF SWITCHES (Megohms)	OPEN SWITCH	300	300	300	300	þ	300	BOURNS	A - B	A - D	B- D	
INSI								-	INSULATION (Megohms)	700	700	100	
	TESTS	TERMINALS	OPEN to CASE	CLOSED to CASE	COMMON to CASE	OPEN to CLOSED	CLOSED to COMMON	OPEN to COMMON	BOURNS INDICATOR TERMINALS	A to GASE	B to CASE	D to CASE	

Table 6-3. Insulation Resistance Test Data

	INSNI	LATION RESISTA	INSULATION RESISTANCE DATA SHEET	Specimen No. 2
TESTS	·	INSULATION RESISTANCE OF SWITCHES (Megodins)	SISTANCE HES s)	REFERENCE TP-RE-FO-1045-2R
TERMINALS		OPEN . SWITCH	CLOSED SWITCH	ALLOWABLE LIMITS. PAR 6.2.2
OPEN to CASE		009	550	Of not form one of
CLOSED to CASE	,	009	550	seconds. Winimum resistance
COMMON to CASE		009	550	allowed - 20 Megohms
OPEN to CLOSED		009	550	
CLOSED to COMMON		ð	550	
OPEN to COMMON		009	0	
BOURNS INDICATOR . TERMINALS	INSULATION (Megohms)	BOURNS TERMINALS	RESISTANGE (Ohms)	ALLOWABLE LIMITS. PAR 6.2.2
A to GASE	100	A - B	0967	500 vdc applied for 60
B to CASE	100	A – D	1157	seconds. Minimum resistance
D to CASE	100	B. D	437.2	allowed - 20 Megohms

Table 6-4. Insulation Resistance Test Data

	INSNI	ATION RESISTA	INSULATION RESISTANCE DATA SHEET	Specimen No. 3
TESTS		INSULATION RESISTANCE OF SWITCHES (Megohms)	SISTANCE HES s)	REFERENCE TP-RE-FO-1045-2R
TERMINALS	Ω	OPEN . SWITCH	CLOSED SWITCH	ALLOWABLE LIMITS. PAR 6.2.2
OPEN to CASE		300	350	
CLOSED to CASE		300	350	500 vdc applied for 60
COMMON to CASE		300	350	seconds, finimum resistance
OPEN to GLOSED		300	350	
CLOSED to COMMON		0	350	
OPEN to COMMON		300	0	
BOURNS INDICATOR TERMINALS	INSULATION (Megohms)	BOURNS TERMINALS	RESISTANCE (Ohms)	ALLOWABLE LIMITS. PAR 6.2.2
A to GASE	100	A - B	4905	500 vdc applied for 60
B to CASE	700	A - D	14887	seconds. Minimum resistance
D to CASE	100	B- D	1,1	allowed - 20 Megohms
		7		

# SECTION VII

# ICING TEST

7.1	TEST REQUIREMENTS
7.1.1	An icing test shall be performed to determine the ability of the specimen to perform under iced conditions.
7.1.2	The icing test shall be performed in accordance with section 14 of KSC-STD-164(D).
7.1.3	The temperature in the test chamber shall be regulated and maintained at 5°F.
7.1.4	Spray nozzles shall emit water in droplets of 1.5 milimeters minimum diameter.
7.1.5	Water, precooled to 40°F, shall flow through each spray nozzle at a rate of approximately 2 gallons per minute.
7.1.6	The spray nozzles shall be located at a minimum distance of 2 feet from the specimen.
7.1.7	Functional tests shall be performed during and after the icing test.
7.2	TEST PROCEDURE
7.2.1	Specimens 2 and 3 were installed as shown in figure 5-1A and placed in environmental chamber (50).
7.2.2	The temperature in environmental chamber (50) was stabilized of +5°F.
7.2.3	Water of 40°F was injected into the chamber. The injection of the water was continued until a minimum of $\frac{1}{2}$ -inch of ice had formed on the specimens. (Figure 7-1).
7.2.4	DOWNSTREAM PRESSURIZATION
7.2.4.1	The procedures described in paragraph 4.2.2.3 through 4.2.2.5 and 4.2.3.1 through 4.2.3.4 were performed.
7.2.4.2	The procedures described in paragraphs 5.2.3.3 through 5.2.3.5 were performed.
7.2.4.3	Valves 16 and 17 were opened and hydrogen flowed through the system. When thermometer 32 indicated a temperature of -423°F, valve 45 was closed and valve 39 was moved to the vent position

- 7.2.5 DOWNSTREAM LEAKAGE TESTS 7.2.5.1 Leak detector 41 was installed as shown in figure 5-1B and valve 17 was closed. 7.2.5.2 The tests described in paragraphs 5.2.4, 5.2.5, 5.2.6, and 5.2.7 were performed. 7.2.6 PURGE The purge procedure described in paragraph 5.2.8 was performed. 7.2.7 UPSTREAM PRESSURIZATION 7.2.7.1 The specimens were removed from the installation, turned 180 degrees, and reinstalled as shown in figure 5-1B. 7.2.7.2 The procedures described in paragraphs 4.2.3.1 through 4.2.3.4 were performed. 7.2.7.3 The procedures described in paragraphs 5.2.3.3 and 5.2.3.4 were performed. 7.2.8 UPSTREAM LEAKAGE TESTS 7.2.8.1 Leak detector 41 was installed as shown in figure 5-1B and valve 17 was closed. 7.2.8.2 The tests described in paragraphs 5.2.4, 5.2.5, 5.2.6, and 5.2.7 were performed on specimens 2 and 3 at 100 psig pressure. 7.2.9 ACTUATOR SIGNAL PRESSURE 7.2.9.1 Leak detector 41 was removed and valve 43 was opened. 7.2.9.2 Regulator 8 was adjusted until a pressure of 50 psig was observed on gage 27. The procedures described in paragraphs 4.2.7.1 through 4.2.7.3 7.2.9.3 were conducted on specimens number 3. 7.2.9.4 Valve 46 was opened and after specimen number 2 closed valve 46 was closed. 7.2.9.4 Valve 39 was opened and opening pressure was supplied to specimen number 3. After specimen number 3 opened, valve 45 was closed, and valve 39 was returned to the vent position.
- 7.2.9.5 The procedures described in paragraphs 4.2.7.1 through 4.2.7.3 were conducted on specimen number 2. Valve 45 was opened at completion of the test.

Valve 46 was opened.

## 7.2.10 PURGE

The purge described in paragraph 4.2.8 was performed.

- 7.2.10.1 The environmental chamber was returned to ambient conditions.
- 7.2.11 Within 1 hour after the icing test had been completed a functional test was performed as described in paragraphs 7.2.4.1 through 7.2.9.

# 7.3 TEST RESULTS

### 7.3.1 SPECIMEN NUMBER 2

- 7.3.1.1 During the icing functional test the specimen began leaking at the packing flange gland. The gland was tightened and the leak was curtailed. The specimen successfully completed the post-icing functional test.
- 7.3.2 SPECIMEN NUMBER 3

The specimen successfully completed the icing and post-icing functional test except the minimum signal pressure and actuator pressure were out of tolerance.

# 7.4 TEST DATA

The data recorded during the icing and post-icing functional tests are presented in tables 7-1, 7-2, 7-3 and 7-4.

														Sp	Specimen No.	No.	2	
_						H	EST	TEST DATA SHEET	SHEET		ŀ						3	
1		Media	•	Temperature	Vacuum	Pressur	Ų.	Domotor Pressure Psig	tor	Leakage sccm	age m	Switches	ches	In	Indicator	ı.	Travel Secs.	rel cs.
	Phase		Inner	Outer	mcrons	In	Τ.,	Act	Sig	Int	Ext	Open	Close	Open	Res Ohms	Sig Psi	Open	Open Close
17 07	Internal Seat	GH <sub>2</sub>	817-	10	21	90	0	8	2.9	5.2	0	OK	OK	0 1/4 1/2 3/4 Pull	09	5.8 8.9 12.1 15.0	4.1	3.9
	Loss of psi	GH <sub>2</sub>	-418	10	77	700	0	0	2.9	6.3	0		OK			·		
1		NOT	REQUIED	CE					·	,				1/2 3/4 Pull				
0032	Internal Seat	GH <sub>2</sub>	-4-8	10	. 21	0	25	50	2.9	0	<b>*</b>							
	Loss of psi	GH2	-418	10	12	0	25	0	0	0	<b>4</b>							
* M < X	Internal Seat	GH 2	817-	30	12	0 ,	25	0	0	0	<b>*</b>							

A Excessive seat leakage about valve stem 6SE 067

Table 7-2. Post-Icing Functional Test Data

Phase   Hedia Temperature   Vacuum   Pressure   Pressure   Southches   Indicator   Temperature   Pressure   Pressure   Pressure   Southches   Indicator   Temperature   Tempea temperature   Tempera							[	TEST DATA SHEET	ATA :	SHEET					Si	Specimen No.	n No.	7	
Internal   CH2   Lus   Couter   In   Cut   Act   Sig   Int   Ext   Open   Close   Open   Ohms   Para   Pa		5	Media	Tempe:		Vacuum	Pres	sure	Domo Press Ps	tor sure	Leak	age m	Scit	ches	In	dicat	or		en vel cs.
Internal (H₂ 418 60 25 100 0 2.9 2.9 2.5 0 100 0 2.0 2.9 2.9 2.5 0 100 0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0		D THE O		Inner					Act	Sig	Int			Close	open	Res Ohms	Sig	-	C105
Internal   GH2   -418   60   25   100   0   20   2.9   2.5   0   11/2   15.0   13.0     Internal   GH2   -418   60   25   100   0   20   2.9   2.0   0   11/2   15.0     Internal   GH2   -418   60   25   100   0   20   2.9   2.9   10.0     Internal   GH2   -418   60   25   0   25   20   2.9   2.9     Internal   GH2   -418   60   25   0   25   20   2.9   2.9     Internal   GH2   -418   60   25   0   25   20   0   0   0     Internal   GH2   -418   60   25   0   25   20   20   0   0     Internal   GH2   -418   60   25   0   25   20   20   0   0     Internal   GH2   -418   60   25   0   25   20   20   0   0     Internal   GH2   -418   60   25   0   25   20   20   20   0     Internal   GH2   -418   60   25   0   25   20   20   20   0     Internal   GH2   -418   60   25   20   20   20   20   20     Internal   GH2   -418   60   25   20   20   20   20   20     Internal   GH2   -418   60   25   20   20   20   20   20     Internal   GH2   -418   60   25   20   20   20   20   20     Internal   GH3   -418   60   25   20   20   20   20   20     Internal   GH3   -418   60   25   20   20   20   20   20     Internal   GH3   -418   60   25   20   20   20   20   20     Internal   GH3   -418   60   25   20   20   20   20   20     Internal   GH3   -418   60   25   20   20   20   20   20     Internal   GH3   -418   60   25   20   20   20   20   20   20     Internal   GH3   -418   60   25   20   20   20   20   20     Internal   GH3   -418				·											ο 1/4	6277			
Lose of psi GH2	54	Internal Seat	GH2	81.4	8	55	8	•			2.5	0	<u> </u>	•	1/2 3/4 Pull	1.2		13.0	
Internal GH2 418 60 25 100 0 50 2.9 2.0 0 1/2 5.9 44.5 5.9 1.0 1 1.2 15.0 1	SHO	of	GH2	-418	8	25	100	0	0	0	2.0	0							
Internal GH <sub>2</sub> -418 60 25 100 0 50 2.9 2.0 0 1/2 3/4 4.5 Seat.  Internal GH <sub>2</sub> -418 60 25 0 25 50 2.9 2.9 Internal GH <sub>2</sub> -418 60 25 0 25 0 0 0 0 0 Internal GH <sub>2</sub> -418 60 25 0 25 0 0 0 Internal GH <sub>2</sub> -418 60 25 Internal GH <sub>2</sub> -418 60 Internal GH <sub>2</sub> -41	< 24 <			. •					*						0	62.77			<
Internal GH2 -418 60 25 0 25 50 2.9 2.9 Seat  Loss of psi GH2 -418 60 25 0 25 0 0 0  NOT REQUIRED	×	Internal Seat	GH <sub>2</sub>	-418-	9	25	97	0		2.9	2.0	0 .			1/2 3/4 Pull	1.2		4.5	° <del>-</del>
Loss of psi GH <sub>2</sub> -418 60 25 0 25 0 0 0 NOT REQUIRED	0032	Internal Seat	GH2	418	8	25	0				2.9								<i>t</i>
NOT REQUIRED	<b>∞</b> ₽ ₽	of psi	GH2	418	9	25	0	25	0	0	0	. 0							
	K M K M		NOT	REQUIR	<b>E</b> D	·													

Table 7-3. Icing Test Data

<del>است</del>						H	EST D	TEST DATA SHEET	HEET					S	Specimen No.	No.	3 Stem	en
		Media	Temperature		Vacuum	Pressur Peta	<u>.</u>	Domotor Pressure Psig	or Jure	Leakage sccm	age m	Skatches	ches	H		or	Travel Secs.	ravel Secs.
	Phase		Inner		microns	In	.,	Act.	Sig	Int	Ext	Open	Close	Open	Ohms	Psi	Open	Close
<b>5</b> A	Internal Seat Leakage	LH2	027-	10	12	700	0	S.	* <b>*</b> *	0	0	OK	OK	0 1/4 3/4 Pull	224	2.7 5.8 8.8 12.0 15.0	4.5	6.3
~ E	Loss of psi	LH2	7.30	10	12	81	0	0		0	0		OK					
KMAX		NOT	REQUIED	(E)			·				·			175 4 E				
SEOD	Internal Seat Leakage	IH2	027	Ot	12	0	25	83	2.6				Ą					
s H	Loss of psi	LH2	027-	or	77	0	25	0	0	0	0		ğ				·	
<b>X</b> M <b>X</b>		NOT	REQUIRED	(E)														
-																		

\* Note change of signal pressure

Table 7-4. Post-Icing Test Functional Data

	n el	0108	· · · · · · · · · · · · · · · · · · ·	5.8			0.9						
3	Stom Travel Secs.	Open Close		15.0			7-7						
No.		Sig	2.6	9.1 12.2 15.0		2.6	8.8	12.0 15					
Specimen No.	Indicator	Res Ohms	4825	23	Ţ	4825	· · · · · · · · · · · · · · · · · · ·	213					
Spe	Ind	Open o	0 7/1	3/4			1/2	3/L Pull		_			
	spes	Close		×	OK					OK	OK		
	Switches	Open (		OK OK									-
	Leakage sccm	Ext		0	0								
		Int		2.0	7.3			4.7		2.5	2.7		
SHEET	Domotor Pressure Psig	Sig		2.6	0			2.6		2.6	0		
TEST DATA SHEET	Domotor Pressur Psig	Act		25	0			50		50	0		
PEST	Pressure	Out		0	0			0		25	25		
	Prog	In		100	700			8		0	0		
	Vacuum	מוס זאווו		25	25			25		25	25		
				09	09			09		62	62	ED	
	Temperature	Inner		-417	-417			-417		-412	-412	REQUIRED	
	Media			CH2	GH <sub>2</sub>			$GH_2$		LH <sub>2</sub>	LH2	NOT	
	Ė	rnase	- Lamo		Loss of psi		Internal Seat	аде	T-+ 0 ====	incerna. Seat Leakage	Loss of psi		
<del></del>	<del></del>			_ ⊃ A.	တ 🗀 း	<b>= E</b>			1	032		* 54 * 74	

Figure 7-1. Icing Test Setup

# SECTION VIII

# CYCLE TEST

8.1	TEST REQUIREMENTS
8.1.1	The specimen shall be subjected to a total of 3000 cycles using LH <sub>2</sub> at 100 psig as the test medium for the valve and $GN_2$ at 50 psig as the test medium for the actuator supply.
8.1.3	A cycle shall consist of opening and then closing the valve.
8.1.3	The actuator position switches shall be loaded to 10 amperes resistive load and 28 vdc during the cycle test.
8.1.4	A functional test shall be conducted after 100, 500, 1000, and 3000 cycles.
8.2	TEST PROCEDURE
8.2.1.1	The specimen was installed as shown in figure 8-1A using the equipment listed in table 8-1. It was determined that all connections were tight, all gages were installed and operating properly, and that all valves were closed.
8.2.1.2	A functional test was performed on specimen 1 because 72 hours had elapsed since the specimen had been previously tested. Specimens 2 and 3 did not require any prestest functional testing.
8.2.2	The actuator position switches were loaded to 10 amperes resistive load.
8.2.3	CYCLING
8.2.3.1	The procedures described in paragraphs 4.2.2.2 through 4.2.2.5 were performed except regulator 8 was adjusted for a pressure of 50 psig.
8.2.3.2	The procedures described in paragraphs 4.2.3.1 through 4.2.3.6 were performed.
8.2.3.3	Valve 16 was opened. Solenoid valve 47 was actuated, deactuated and actuated by timer 48. These actions allowed the specimen to close, open, and close. This activity constituted 1 cycle.
8.2.3.4	Three thousand cycles were performed.
8.2.4	FUNCTIONAL TEST

A functional test as described in paragraphs 4.2.4 through 4.2.10 was performed after 100, 500, 1000, and 3000 cycles.

8.2.6 PURGE

A purge ws described in paragraph 4.2.8 was performed after the functional test at 3000 cycles.

#### 8.3 TEST RESULTS

#### 8.3.1 SPECIMEN 1

The specimen failed the precycle functional test. The valve cracked at a signal pressure of 2.4 psig and a 50 psig actuator pressure. The specimen was disassembled and the springbutton adjusting assembly of the domotor was found to have rotated. This rotation changed the signal pressure. The failure is shown in figures 8-3 and 8-4. The two adjustment screws provided on the button will not lock on the retainer seal tube. This failure allows rotation of the button and changes the signal pressure, cracking pressure, and reseat pressure. Although the lock screws were torqued until the screw slots failed, the button was still able to be rotated with the consequent changes of adjustments.

- 8.3.1.1 The two adjustment screws from specimen 2 were used to replace the screws from specimen 1. These screws seemed to function properly and retain the button in one position. The specimen was reassembled and readjusted according to CCSD-FO instructions dated 12-12-66.
- 8.3.1.2 The signal pressure adjustment mechanism of the specimen cannot be relied upon to maintain an exact adjustment as required by John F. Kennedy Space Center. The exact cause could not be determined due to the limited scope of the test procedure but test results indicate the following problem areas:
  - a) Insufficient mechanical locking of the springbuttons.
  - b) The valve adjustment mechanism cannot furnish adequate control of the domotor mechanism.
- 8.3.1.3 The specimen failed the leakage requirements after 1500 cycles. Testing revealed that the internal valve seats began failing after 1000 cycles. This was caused by deterioration of the valve seat material.
- 8.3.2 SPECIMEN 2
- 8.3.2.1 The specimen was tested within the specified signal pressure range of 2.9 to 15 psig.

8.3.2.2 The specimen failed the leakage requirements after 1000 cycles. The valve was disassembled and inspected. The valve plug (SS) was worn, the seal-seat (Kel-F) was worn, the seal-creavey (Teflon) was compressed and the pressure ring (SS) was loose. This is shown in figures 8-5 and 8-6.

#### 8.3.3 **SPECIMEN 3**

- 8.3.3.1 The specimen was tested within a signal pressure range of 2.4 to 15 psig.
- 8.3.3.2 The specimen failed the leakage requirements upon completion of the 3000 cycles. It is believed that the failure may have begun after 1500 cycles.
- 8.3.3.3 Upon completion of the cycle test the specimen was adjusted as per CCSD-FO instructions dated 12-2-66 and 12-5-66. An additional functional test was conducted on 1-11-67. The signal pressure adjustments were found to have changed. The specimens cracking pressure was 2.8 psig, but was originally adjusted for 3.0 psig. This change occurred during layup or aging and was not due to any functional operations.
- 8.3.3.4 The specimen was readjusted and the internal leakage failed to meet the test requirements. Readjustment of the specimen did not overcome the previous leakage failures.

#### 8.4 CONCLUSION

The signal pressure adjustment of the domotor will not maintain the specimen within the minimum 2.9 psig signal pressure requirements.

8.4.1 The valve plug and seat seal will not withstand more than 1000 cycles and still remain within the specified internal leakage requirements.

Table 8-1. Cycle Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
		† <u></u>		I	
1 1	Test Specimen	Annin Company	1760	NA.	
2	Pressure Source		NA	NA	3000-psig GN <sub>2</sub>
3	Hand Valve	Hoke	PY273	NA	t-inch
4	Pressure Gage	Union Carbide	<b>2</b> 9172 <b>-</b> 1	NA ·	0-to 100-psig
5 6	Pressure Gage	Union Carbide	29172-1	NA	0-to 100-psig
	Pressure Gage	Union Carbide	29177-1	NA.	0-to 400-psig
7	Pressure	Victor	SR431	859279	0-to 50-psig
	Regulator	·			
8	Pressure	Victor	SR431	859273	0-to 150-psig
	Regulator	ĺ			
9	Pressure	Victor	SR431	859203	0-to 150-psig
	Regulator			,,,,,,	,, p
10	Pressure Gage	Victor	22660-1	NA.	0-to 1000-psig
11	Pressure Gage	Union Carbide	29177-1	NA	0-to 400-psig
12	Pressure Gage	Victor	22660-1	NA	0-to 4000-psig
13	Pneumatic Valve	Hoke	30201-1	NA	t-inch
14	Pneumatic Valve	Hoke	30201-1	NA.	t-inch
15	Pneumatic Valve	Hoke	30201-1	NA NA	t-inch
16	Pneumatic Valve	Hoke	DR294AJ	NA NA	t-inch
17	Pneumatic Valve	Hoke	30201-1	NA NA	t-inch
18	Hand Valve	Control	30455	NA NA	t-inch
10	Heritor Acrive	Components	70477	, MA	4-Inch
19	Hand Valve	Powel1	NA NA	8157	
20	Pressure Gage	US Gauge CD	10895	NA	0-to 30-Vac
20	rressure Gage	03 Gauge CD	10895	NA	0-to 300-psig
21	Pressure Gage	Supergrand	-B-	106 1101	0-to 160-psig
21	rressure Gage	Supergauge	<b>-</b> D-	100-1151-	
				D	+0.5% FS
				Ì	Cal date
			Į	l	10-1-66
] [		1	20 005	NTA:	0 += 1000 ===
22	Pressure Gage	Victor	30-205-	NA	0-to 4000-psig
	<b>D</b>	774 -A	203 701N	869954	0 += 250 =====
~>	Pressure	Victor	LOTH	007774	0-to 250-psig
	Regulator	<b>A</b> • • • •	NTA.	NA NA	
	Hand Valve	Airco	NA NA	NA NA	1800-psig He
25	Pressure Source	Airco	NA	) NA	1800-psig He
_,		Helium Bottle		05 3560	0 4 - 204 -
26	Pressure Gage	Duragauge	-B-		0-to_30-psig +0.5% PS
				B	
		<b>1</b>		051200	Cal date 10-7-66
27	Pressure Gage	Heise	-B-	ADT7AR-R	0-to 160-psig
l ·					±0.5% FS
	_		1_	1206 3330	cal date 10-7-66
28	Pressure Gage	Supergauge	-B-		0-to 160-psig
1		}		B	± 0.5 % FS
					Cal date 10-7-66
	<u></u>		<u> </u>	<u> </u>	l

Table 8-1. Cycle Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
29	Pressure Gage	Heise	-B-	]	0-to 60-psig ± 0.1 % FS
30	Pressure Transducer	CEC	NA	018169	Cal date 10-7-66 0-to 100-psig +0.5% FS Cal date
31	Pressure Transducer	CEC	NA	018170	10-7-66 0-to 100-psig +0.5% FS Cal date 10-7-66
32	Resistance Thermometer	Rosemount	150MA32	6454	-415 to -430 °F +0.5°F
33	Thermocouple	Copper Constantan	NA.	NA	cu, con +2°F
34	Vacuum Thermocouple	NRC Equipment Corp.	Type 0521	NA	Cal date 9-15-66
35	Vacuum Valve	Cryolab	SVI 84-5W2	NA	inch
36	Vacuum Pump	Welch	010587	9863-97	
37	Check Valve	Lukenheiman	2144	NA.	2-inch, ventical
38	Back Pressure Regulator	Fisher	NA	4140132	1-inch
39	Hand Valve	Republic Mfg.	NA.	424	1-inch
40	Recording Oscillograph	CEC	NA	012592	Cal date 6-27-67
41	Leak Detector	CCSD	NA	NA	
42	175 Liter Dewar	Cryenco	195-L	1158-19	IH <sub>2</sub>
43	Hand Valve	Robbins	55KG250	NA	60 <b>0</b> 0-psi
44	Hand Valve	Robbins	55KG250	NA	6000-psi
45	Hand Valve	Robbins	55KG250	NA	6000-psi
46	Hand Valve	Robbins	55KG250	NA	6000-psi
47	Solenoid Valve	Marotta	MR74	NA.	3000 <b>-pp</b> ig
48	Timer	Wilson	Mod #1	NA	Repeat cycle timer
49	Venting Kegulater	Tescom	26-1610 42-031	2505	0-to 100-psig
50	Environmental Chamber	CCSD	NA	NA	
51	DC Power Supply	Lambda	LA-100- 03-BM3	010265	28-VDC Cal date 10-16-66
52	Load Resistor	Sun-Elec. Company		08-113 010851	10 Amperes Cal date 8-4-66
53	Ammeter	Sun-Elec. Company	NA	NA	Cal date 8-4-66

Table 8-2. Pre-Cycle Functional Test Data

Phase   Media   Temperature   Vacuum   Pressure   Pressure   Pressure   Pressure   Pressure   Secondary   Secondary   Pressure   Pressure   Secondary   Secondary   Pressure   Pressure   Secondary   Secondary   Pressure   Pressure   Secondary   Secondary   Pressure   Pressure   Secondary   Pressure   Pressure   Pressure   Secondary   Pressure   Pressure   Pressure   Secondary   Pressure   Pressure   Secondary   Pressure   Pressure   Pressure   Secondary   Pressure   Pressure   Pressure   Secondary   Pressure   Pressure   Secondary   Pressure   Pressu						<b>'</b>			ľ								Sten	E
Timer   Outer   Oute		Media			Vacuum	Pres		Domot Press	or	Leak	age n	Swit	ches	# 	dicat	or	Travel Secs.	ravel Secs.
mal         GH2         4.18         46.4         2         100         0         30         2.9         *2         4.2         100         0         30         2.9         *2         100	Phase		Inner	_	microns		1,3	Act	Sig	Int	Ext		Close		Res Ohms	Sig Psi	Open	Open Close
Heli GH2 4.18 46.4 2 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Internal Seat	GH2	418	7.97		100	0	8	2.9	۲ *				0 1/2 3/4 Pull			₹	
H2 418 46.4 2 100 0 50 2.4 *3 0 0K 1/2 1/2 1/1	of of	GH <sub>2</sub>	418	7.97	R	100	0	0	0	0	0		S.					
GH <sub>2</sub> 418 46.4 2 0 25 50 2.4 *3 sill GH <sub>2</sub> 418 46. 2 0 25 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Internal Seat	GH2	817	7.97	ત	001	0	55	2.3	o #	0	OK	OK	1/2 1/2 3/4 Pull		2.3 5.0 8.3 11.4	0.4	3.0
351 GH <sub>2</sub> 418 46. 2 0 25 0 0 0 0 GH <sub>2</sub> 418 46 2 0 25 2.8 *4	Internal Seat	ر ج ج	817-	7.97	N	0	25	50	2.3	o %	0							
GH <sub>2</sub> 418 46 2 0 25 2.8 *4	Loss of psi	GH2	418	.94	. 2	0	25	0	0	0	0							
	Internal Seat	GH2	418	97	R	0	\$2		2.7	0 **	0			······························				ુમ'

\*3 Valve cracks at 2.4 signal pressure. \*4 Valve cracks @ 2.8 psig.

8-6

Table 8-3. Post-100 Cycle Functional Test Data

						F	TEST DATA SHEET	ATA S	HEEL			·		Sp	Specimen No.	No.	1	
		Media		Temperature	Vacuum	Pressure		Domotor Pressure	or	Leakage	age n	Switches	1	Ĕ	Indicator	ř	Stem Travel Secs.	em vel cs.
	Phase		Inner	_	microns	In Out	Τ.,	Act	Sig	Int	Ext	Open	Close	Open (	Res Ohms	Sig Psi	Open	Open Close
	Internal Seat	GH <sub>2</sub>	418	+50.5	1	100	0	8 %	2.9	00	00		¥	0 1/2				
Д										Valve	cracks	cks						
Ø ₽ 6	Loss of psi	GH2	814-	50.5	٦	100	0	0	<b>.</b> 0	0	0							
* 2 4 4 7	Internal Seat	GH2	817	50.5		001	0	50 50	2.6	2.6 0 0 2.7* Excessiv	O		:	1/4		2.2 2.3 2.4 2.7 2.0	0.4	4.5
							1		1	1	1	T		1				
REOR	Internal Seat	GH2	-418	+50.5	ת	0	53	22	2.7	Valve	o Cracks	cks						
0 H A	Loss of psi	CH2	-418	50.5	T	0	25	0	0	0	0							
<b>X</b>	Internal Seat	· CH2	817-	50.5	Н	0	25	8	3.0	0	0							
			].								1							

\* Cracking pressure changed to 2.7 psig

Table 8-4. Post-500 Cycles Functional Test Data

<u> </u>							EST D	TEST DATA SHEET	HEET					Sp	Specimen No.	No.	1	
		Media	Temperature	ature	Vacuum	Pressure		Domotor Pressure	or	Leakage	age n	Switches	shes	Ĭ	Indicator	ž	Stem Travel Secs.	en rel
	Phase				microns	In Out	1.	Act,	Sig	Int	Ext	Open Close		Open	Res Ohms	Sig	Open	Close
DA	Internal Seat	GH <sub>2</sub>	917-	62	12.0	100	0	8	2.8	12cc/min	mim	<b>*</b>		0 1/2 3/4 Pull			*	
o H	Loss of psi	GH2	-418	62	12.0	100	0	0	0	77								
<b>X</b>	Internal Seat	GH2	814-	95	12.0	100	00	50	2.8	14 Valve	crecks	cks		0 1/4 1/2 3/4 Full		2.8 5.8 9.1 12.0 15.2	0.4	4.0
ZZOR	Internal Seat	GH <sub>2</sub>	-418	62	12.0			50	2.8 4.0	7.0								·
SHO	Loss of psi	GH <sub>2</sub>	-418	62	12.0	0	25	0	Φ.	0.9	0						·	
K M K M	Internal Seat	GHZ	418	62	12.0	0	25	0	δ. 	5.5	0			·	·			
		240000	at 2.05	sional	pressure and reseats	e and	rese	ats a	at 2.90	ၟ	1							

\*1 Valve cracks at 2.95 signal pressure and reseats at 2.90 \*2 20 psig will not open valve - 27 psig will

Table 8-5. Post-1000 Cycles Functional Test Data

	cm vel	Close			0.4			
1	Stem Travel Secs.	Open			4.2			
No.	r.	Sig			2.8 *5.8 9.0 12.1 15.0			
Specimen No.	Indicator	Hes Ohms					#	
S	uI	Open	0 1/4 3/4 Full		0 1/4 3/4 Pull			
	Switches	Close						
	Sırit	Open				nin		
	Leakage scem	Ext	ô	5		0 cc/nin	- 10	10
E		g Int		0 9.5	16.	0.6	0 8.5	3 10.5
TEST DATA SHEET	Domotor Pressure Psig	t Sig	2.8		2,8	2.8		2.8
DAT			8	0	50	8	0	- 50
TEST	Pressure Pete	) Gr	0	0	0	25	25	25
	<b> </b>	-	100	901	700			
	Vacuum	meet our	10.0	10.0	10.0	10.0	10.0	10.0
	Temperature	Outer	58	58	58	58	58	58
		Inner	-418	817-	-418	817-	-418	-418
	Media		GH <sub>2</sub>	$_{ m CH}_{ m Z}$	GH2	GH <sub>2</sub>	GH2	GH 2
	Ē	rnase	Internal Seat	Loss of psi	Internal Seat	Internal Seat	Loss of psi	Internal Seat
	<u> </u>		n a	თ <b>⊢</b> ი	KMAX	ZZOG	SEA	H K X

\* Cracking pressure at 3.0 signal pressure

 $\Delta =$  indicates failure

Table 8-6 Post-1500 Cycles Leak Test Data

	el s.	Close			,		·			
	Stem Travel Secs.	Open Close								
No.	<u> </u>	Sig								
Specimen No.	Indicator	Res Ohms								
Spe	Inc	្តទ	1/4 1/2 3/4 Full		1/4					
	shes	Close			OK					
	Switches	Open								
	Leakage sccm	Ext			• •	1				
Ħ	<b></b>	Int	·····		335	-				_
TEST DATA SHEET	Domotor Pressure	Sig			2.8	-				$\dashv$
r DAT	Do:				0 50	-				-
TEST	Pressure	In Out	<u></u>		100	+				_
		<u> </u>				1	<u></u>			
	Vacuum	micr			12	_				_
	Temperature	Outer			27				:	
	Tempe	Inner			-418					
	Media				GH <sub>2</sub>					
		Phase			Internal Seat					
L			DА	o E-	K M A X		9032	ა <b>⊢</b>	KMKX	_

 $\Delta$ = Indicates failure

Table 8-7. Post-2000 Cycle Leak Test Data

		1	01			-						1					7
	in e)	8.	Close														
	Stem Travel	Secs	Open									٠					]
No.		-	Sig					<del></del>							<del></del>		1
Specimen No.	Indicator					$\dashv$			· · · · · · · · · · · · · · · · · · ·								1
Spec	Indi		e Res		~ +	ıal		-+	2 4 5	<u> </u>	<del>- 12</del>		<del></del>			•	-
			9	0/1	3/4	F		0 1/4	34 4	-				-			-
	Switches		Open Close														_
	8		Open														
	Leakage		Ext														
	-		Int				<		33.5								
SHEET	tor	Psig	Sig	· .	- المراجعة			·	2.8						<del></del>		_
test data sheet	Domotor	Ps	Act						88								
EST		Data	Out						0					<u> </u>			
•		2 4	In						8								
		Vacuum	ncrons			• .			18								
		Temperature	Outer						077+								
		rempe.	Inner						418								
		Hedia	<del></del> .						CH2						,		
		i	Phase					,	Internal Seat							,	
<u> </u>					2	۵,	o E-	<b>成区</b> <		上	00	<b>3 2</b>	ø ₽	民区	<b>1</b> 4 7	4	_

**∆**=Indicates Failure

Table 8-8. Post-2500 Cycle Leak Test Data

7	Stem Travel Secs.	Open Close						
n No.	or	Sig					ļ	
Specimen No.	Indicator	Res Ohms						
Sp	Tr.	Open	0 1/4 3/4 Full		1/2			
	l .	Close						
	Swatches	Opern						·
	Leakage sccm	Ext						
		Int			6.0			
TEST DATA SHEET	Domotor Pressure	Sig			8.0	<u>'</u>		
DATA	e Pre	1			88			
TEST	Pressure	in Out			00			1
	<b> </b>	17			100	ļ	-	
	Vacuum	microns	,		12		,	
	Temperature	Outer			877			
		Inner			-300			
	Media		·		GH <sub>2</sub>			
		Phase			Internal Seat			
<b>L</b>			ÞΑ	SHO	X M X	803	, W.F	<b>X</b> M M M

Table 8-9. Post-3000 Cycles Functional Test Data

Specimen No. 1	ndicator	Open Close Open Ohms Sig Open Close	1/4 1/2 3/4 Full		OK OK 1/2 6.0 4.1 4.0 12.2 Pull 15.6	ОК	0	0
ET	Leakage sccm	g Int Ext	8 15.5 0	20	8 11.5 seem	8 7.8 0	0.11.0	0.7
TEST DATA SHEET	Domotor Pressure Paig	Act. Sig	20 2.8	0	50 2.8	20 2.8	0	50 2.8
TEST	Pressure	In Out	100 0	100	0 001	0 25	25	<del></del> -
	ature Vacuum		54					Ŋ
	Temperature	Inner Outer	917-	-418	007	-418	-418	-418
	Media		GH2	GH2	GH2	GH 2	GH2	GH2
	ı	rnase	Internal Seat	Internal Seat	Internal Seat	Internal Seat	Loss of psi	Internal Seat
			a D	SH	<b>X</b>	AOBZ	თ <b>t</b> + o	K M K K

\* Valve cracks at 3.0 Signal pressure

Table 8-10. Post-100 Cycles Functional Test Data

					<b>A</b>	EST E	TEST DATA SHEET	SHEET					Sp	Specimen No.	No.	2	
	Media	Temperature		Vacuum	Pressure		Domotor Pressure Psig	tor	Leakage	age n	Switches	ches	H,	Indicator	ų	Stem Travel Secs.	re]
Phase		Inner Outer	_	mcrons	In	دد	Act	Sig	Int	Ext	Open	Close	Open	Res Ohms	Sig	Open	Close
Internal Seat	GH2	-418	65	30	300		&	2.9	3.0	0	OK	OK	0 1/4 3/4 Full	1,2	2.9 6.8 10.0 12.9	п.5	5.2
Loss of psi	GH2	-418	99	30	100	·	0	0	2.0	0							
Internal Seat	GH <sub>2</sub>	-418	99	30	100		50	2.9	2.0	0	OK	OK.	1/2 3/4 11/2 11/3	4503	2.9 6.3 9.5 12.5 15.0	0.4	5.0
Internal Seat	GH <sub>2</sub>	-418	99	30		25	8	2.9	77.7	0						·	
Loss of psi	GH2	817-	<b>59</b>	30		25	&	2.9	5.6	0				·			
Internal Seat	GH 2	-4.18	59	30		25	0	0	10.0	0		•	,				·
										1							

Table 8-11. Post-500 Cycles Functional Test Data

						<b>H</b>	EST	TEST DATA SHEET	SHEET					S	Specimen No.	n No.	2	
	Phase	Media		Temperature	Vacuum	Pres	Pressure Pair	Domotor Pressure Psig	tor sure ig	Leakage sccm	age m	Switches	ches	In	Indicator	or.	Stem Travel Secs.	e] s.
ı			Inner	Outer		In		Act	Sig	Int	Ext	Open Close	Close	Open	Res Ohms	Sig Psi	Open Close	Close
<b>5</b> A	Internal Seat	1.H2	-418	594	8	100	·	&	2.9	0	0			1 1 1 1 1	τις <sub>7</sub>	2.9 6.9 10.1 12.8	5.8	5.8
<b>∞ ⊩</b> a	Loss of psi	IH2	-418	+65	8	100		0	0	0	0			Full	1.3	15.0		
K N X	Loss of psi	LH2	917-	+65	ଷ	100		ß	2.9	0	0			0 1/2	1.3	2.9 6.1 9.1 12.3 15.0	0.4	5.0
BEEOR	Internal Seat	<sup>Z</sup> HI	-418	59+	8	0	25	8	2.9	0								
ഗ <b>ല</b> മ	Loss of psi	LH2	-418	+65	8	0	25	0	0	0							<del> </del>	
<b>X&gt;</b>	Internal Seat	IH2	81.4-	59+	&	0	25	50	2.9	0					·			
						1	1	1	1	1	1	1		1		1	1	7

Note: Value cracks @ 50 psig at 3.1 signal pressure

Table 8-12. Post-1000 Cycles Functional Test Data

L						H	TEST D	DATA SHEET	HEET		•		(S	Specimen No.	n No.	7	
	ı	Media	Temperature	rature	Vacuum	Pres	9	Domotor Pressure	or	Leakage		Switches	Ä	Indicator	cor	Tra	Stem Travel Secs.
	Phase		Tungr	_	microns	In	Pare	Act	Sig	Int E	Ext Open	a Close	Open	Res Ohms	Sig	<del>                                     </del>	Open Close
	Internal Seat	GH2	817-	69.1	25	91	·	8	2.9	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\			3/4 2/4	4511	2.9 6.3 10.2 12.3 15.0	5.6	5.3
<b>∞</b> ⊢ ι	Loss of psi	GH2	-418	69.1	25	100		0	°	33.8							
	Internal Seat	GH <sub>2</sub>	4.18	69.1	\$2	100		\$	2.9	<b>%</b>	·		172 77	-1-1-1-1-	2.9 6.0 9.1 11.9 15.0	20100	5-
BOBE	Internal Seat	₩,	2017-	69	\$3		55	ଷ	2.9	excessiv	*	•	1, 1				
	Loss of psi	e H	LO17-	69	25		25	0	70	ехсева	ssive						
<b>X</b>	Internal	. He	2017-	69	25		35	50	2.9	excess in	Bsiv		<u></u>	· · · · · · · · · · · · · · · · · · ·			٠.
1				1	E.	-00		did	not	stop le	leakage.	ł		sconti	Lnued		

A accrease in sign

Table 8-13. Post-100 Cycle Functional Test Data

Hase	1.														Sp	Specimen No.	No.	3	`
Nedia   Temperature   Vacuum   Pressure   Pressure   Scom   Switches   Switches   Inner Outer   In   Out   Act   Sig   Int   Ext   Open   Close   Open   Open   Close   Open   Inner Outer   In   Out   Act   Sig   Int   Ext   Open   Close   Open   Open   Inner Outer							H	EST	DATA S	HEET								ė	
Index   Outer   Index   Index   Index   Sig	1.		Media	Temper		Vacuum	Pres		Domot Press Psj	or	Leak	age n	Swit	ches	II,	dicato	£,	Travel Secs.	is is
IH <sub>2</sub>   -418   65   30   100   0   25   2.5   0   0   0K   1/2   1/4		Phase		Inner		microns	In	.,	Act	Sig	Int	<del>  </del>		Close	Open	Res Ohms	Sig Psi	Open	Close
H <sub>2</sub>   -4.18   65   30   100   0   0   0   0   0   0   0   0		Internal	LH2	-418°	1		82	0	25	2.5	0	0	OK	OK	0 1/4 1/2 3/4 Full	216	6.0 9.5 12.5 15.0	14.2	5.8
IH2   -418   65   30   100   0   50   2.5   0   0   0     1/2   1/4     1/4     1/2	1	Loss of psi	LH2	-418	65	30	8	0	Ø	0	0	0	OK	OK					
mal     IH2     -418     65     30     0     25     25     2.5     0       of psi     IH2     -418     65     30     0     25     0     0     0       mal     IH2     -418     65     30     0     25     50     2.5     0	1	Internal	IH2	418	. 69	30	100	. 0	8	2.5	0	0	OK.	OK	0 1/4 1/2 3/4 Pull	216	5.7 8.8 11.8 15.0	3.4	5.8
of psi         1.H2         -4.18         65         30         0         25         0         0         0         0           mal         1.H2         -4.18         65         30         0         25         50         2.5         0		Internal Seat	IH2	-418	99	30	0	25	52	2.5	0	0							
mal LH2 -418 65 30 0 25 50 2.5 0		Loss of psi		418	- 59	30	0	25	0	0	0	0							
		Internal Seat	टक्षा	418	65	30	0	\$2	R	2.5	0	0					·		

Table 8-14. Post-500 Cycle Functional Test Data

							EST	TEST DATA SHEET	SHEET					Ś	Specimen No.	n No.	8	
		Media		Temperature	Vacuum	Pressu	8	Domotor Pressure Paie	tor	Leakage	age H	Switches		Ä,	Indicator	)r	Stem Travel Secs.	Stem ravel Secs.
	Pase		Inner		arcrons -	S		Act	Sig	Int	Ext	Open	Close	Open	Res Ohms	Sig Psi	Open	Close
	Title													0 1/4	7067	2.6	,	
<b>D</b> A.	Seat	LH <sub>2</sub>	8T%	<b>6</b> 5	8	90	0	25	2.6	0	0	OK K	OK	1/2 3/4 Pull	315	9.4 12.5 15.0	14.0	5.8
Ø F-1	Loss of psi	IH2	. 81%-	. 65.	8	87	0	0	0	0	0	¥	OK					
X M A X	Internal		9.7	7	8	٤		. 5	7 0	c	C	ځ	Š	0 1/4	2067		3.7	. 4
	5 <b>08</b> 7	142	9	60	8	3	)	2	o ·	>	>	5	5	17 A	315	12.1	;	}
AOBE	Internal Seat	LH <sub>2</sub>	817-	99	ଷ	0	25	25	0	0	0,							# : -
on to t	Loss of psi	IH <sub>2</sub>	-418	65	20	0	25	0	0	0	0							
(M < X	Internal Seat	IH2	817-	59	8	0	25	S.	0	0	0							
										1	1							

Table 8-15. Post-1000 Cycles Functional Test Data

						H	EST 1	TEST DATA SHEET	SHEET					Sp	Specimen No.	No.	3	
	Q	Media		Temperature	Vacuum	Pres	Pressure 'Psi <i>e</i>	Domotor Pressure Psig	tor sure ig	Leakage sccm	age a	Switches	ches	ri .	Indicator	J.C	Stem Travel Secs.	is:
	11606		Inner	Outer		In	.,	Act	Sig	Int	Ext	Open	Слозе	Open	Res Ohms	Sig Psi	Open	Open Close
Ω	Internal Seat	гн <sup>2</sup>	817-	69.1	25	100	0	25	2.5	<b>15.8</b>	0	OK V	O.K	0 1/2	0167	5.8 9.1	ריית	5.8
A. 0.					,				J					בות.	374	15.0		
) <b>(</b> + 0	Loss of psi	IH2	-418	1.69	25	100	0	0	0	2.8	0	ğ	ğ					
X A X	Internal	n.	. & L 7	1 07	36	ωι	O	Ç	76	7	C	Š	ž	0 1/4 1/2	0167	5.8 8.8	3.8	5.8
		2m	3	7.5	(3	3	>	₹	;	;	,	5	5	3/4	374	11.8		
903	Internal Seat	гнг	418	12	25	0	25	25	2.4	4.2	0							
<u>ප</u> ග	9	Ë	017	5	36	C	,	C	C	-	c							
i 克克 Ind	Ted to sen	22 .	3	1	3	<b>P</b>	3	>			,							
< ×	Seat	TH2	418	n	25	0	52	8	2.4	4.5	0			,				
	A T-41 cot 62					]				'								

Andicates failure

Table 8-16. Post-3000 Cycles Functional Test Data

						F	est d	TEST DATA SHEET	HEET					ď	Specimen No.	No.	~	1.
								Donotor	cor	Leakage	- sgr	Settches	hes	A	Indicator	£.	Stem Travel	re]
_		Modia	ampeladman atpon		wierons .	Pale		Paig	8		7			-	808	810	8	
-	9860		Inner	Outer		1		Act	Sig	Int	Ext	S S	C1086	Open	State	Pai	Open	Open Close
1										<				0 47	4915	2.4° 5.8°		
_	Internal	1H2	, y , 9(7)	· 65	H	9	0	3	2.4	%. <del>\</del>	0	ð	ð	2/1		9.0	0.47	5.6
, A,	,	<b>y</b>			• .					1			•	Sell Table	315	15.0		
	loss of psi	IH2	418	<b>6</b> 5	1	907	. 0	0	0	47.6	0				•		·	
<b>CK P</b>										<				0	4915	**		٠
9 4 7	Internal		. `.	* 4	•	۶	C	Ş	7.6	\\ \\	0			1/2		8.6	3.8	3.3
	Sest	1.H2	9	6	4	}	<b>)</b>	₹	,					3/4	315	12.1		
1											T							
	Internal		7.07	. 65	н	0	25	\$	2.4	7.3	0		• 					
××		·			-													
თ ₽-	Loss of psi		2017-	<b>.6</b> 5	H	0	25	0	0	6.2	0							
oc M																		
4×	Internal Seat		707	65	H	0	25	ß	2.4	5.0	0							
						,												

A = Indicates failure

8-20

(シャカ)

Table 8-17. Post-Readjustment of Specimen

							ST L	TEST DATA SHEET	HEET					, J	Specimen No.	20.0		
						•											Stem	, ga
		Media	Media Temperature		Vacuum	Pressure		Domotor Pressure Psig	cor sure	Leakage sccm	ම සි ස	Switches		Ä,	Indicator	J.O		ravel Secs.
<u> </u>	Phase	<b>,</b>	Inner Outer		microns	In	1.	Ąct	Sig	Int	Ext	Open	Close	Open	Res Ohms	Sig Pai	Open	Close
D G	Internal Seat	LH <sub>2</sub>	817	38	7	18	0	25	2.9	13	0			0 1/4 3/4 Full		6.1 9.4 12.4 15.0	8.0	4.1
<u> </u>	Loss of psi	IH2	-418	38	4	92	0	0	2.9	(33)	0							
≠₩ <b>∢</b> ¥	Internal Seat	IH2	.81%-	38	7	100	0 .	50	2.9	(60.0)	0			0 1/4 1/2 3/4 Fall		6.2 9.3 12.3 15.0	<b>β.</b> β.	4.2
E S S E	Internal Seat	₩	.2017-	38	7	0	25	25	2.9	8.0	0				·		,	
L	Loss of psi	Не	-407	38	7	0	25	0	2.9	7.0	0							
E N ≪ X	Internal Seat	. He	807-	38	4	0	25	20	2.9	0.4	. 0							

△
 ▼ Indicates failure

ρ,  $\pi$ Figure 8-1. Cycle Test Schematic 8 45 LH2 © % <u>6.</u> ½+inch insulated 7

Note: All lines & inch unless ofherwise indicated. Refer to table 8-1, for item identification.

Note: Kefer to table 8-1 for item identification.

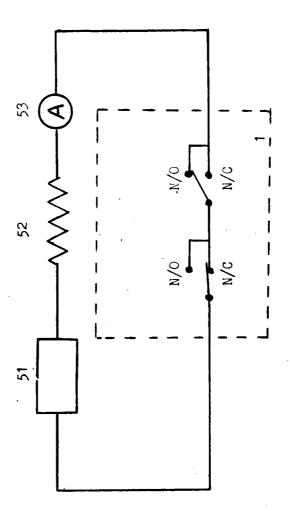
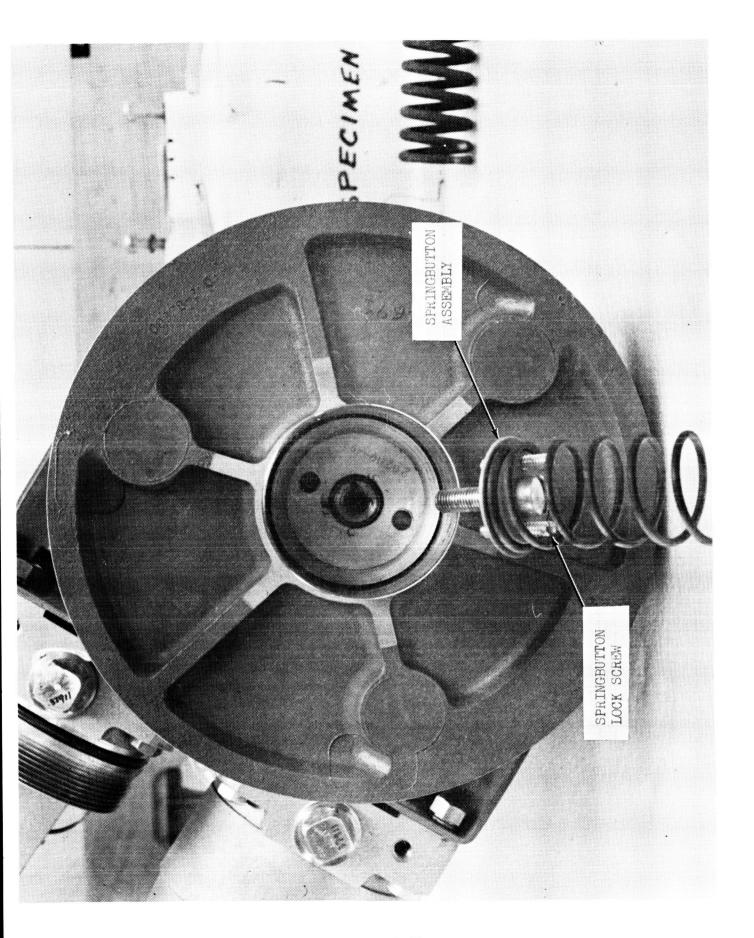
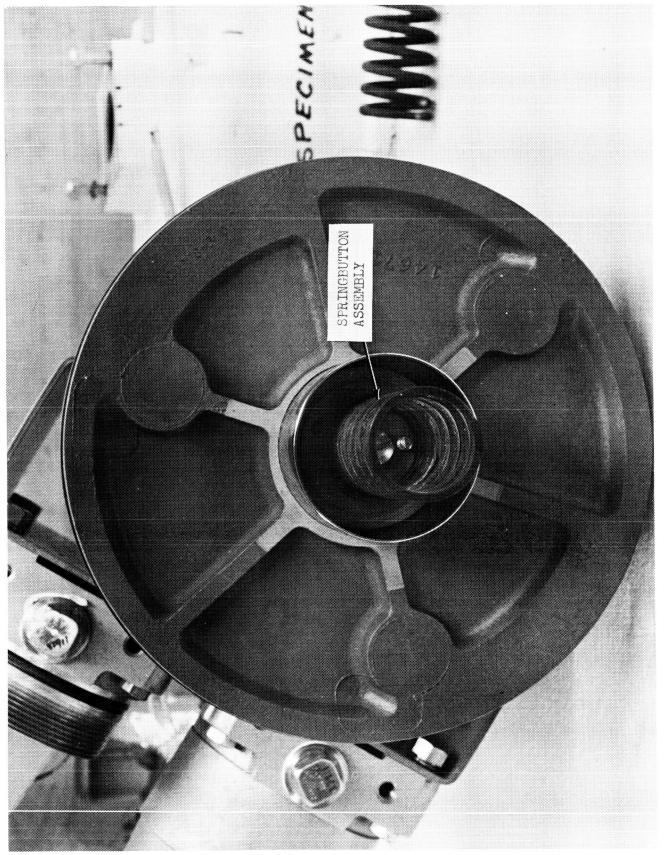


Figure 8-2. Cycle Test Electrical Schematic



Specimen Number 1 Springbutton Assembly

Figure 8-4.



8-25

Figure 8-5. Disassembly of Specimen Number 2



#### APPROVAL

### TEST REPORT

FOR

GLOBE VALVE,  $1-\frac{1}{2}$ -INCH, 100-PSIG,

PNEUMATICALLY OPERATED

ANNIN COMPANY MODEL NUMBER 1760-15016ASA

NASA Drawing Number 75M13138 HCLV-3

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